INTERNATIONAL NICKEL

Press Reference Book 1969

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The purpose of this book is to present concise, up-to-date information about the activities and operations of The International Nickel Company of Canada, Limited, and its two principal subsidiaries, The International Nickel Company, Inc. in the United States and International Nickel Limited in the United Kingdom.

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We hope you will find this manual a valuable source of information about International Nickel, the world's leading nickel mining and marketing organization.

In these pages, you will find concise, up-to-date information about International Nickel's mines, plants, exploration efforts and marketing and research activities.

Also included are a ten-year review of financial facts, a brief history of the company, and biographies of the company's officers.

SCOPE OF OPERATIONS

The International Nickel Company of Canada, Limited is the world's leading producer of nickel. It mines, refines and markets nickel throughout the free world. The company is also an important producer of copper and the platinum-group metals. Other by-products recovered in its nickel operations include iron, cobalt, gold, silver, selenium, tellurium and sulphur.

Personnel: At the end of 1968, the company and its subsidiaries had 33,314 employees in 18 countries, including 24,378 in Canada, 4,671 in the United Kingdom, and 4,265 in the United States and other countries.

Nickel Deliveries: In 1968, these totaled 480,840,000 pounds of nickel in all forms, compared with 463,450,000 pounds in 1967.

Deliveries of Other Metals: The company delivered 314,160,000 pounds of copper in 1968, compared with 310,930,000 pounds the previous year. Deliveries of the platinum-group metals (platinum, palladium, rhodium, ruthenium, iridium and osmium) and gold were 440,900 troy ounces last year, compared with 475,600 ounces in 1967. Iron ore deliveries amounted to 654,000 long tons, compared with 708,000 long tons in 1967.

Shareholders: The number of shareholders of record at March 24, 1969 was 79,636. The company's shares are listed on the Toronto, Montreal, New York and London stock exchanges, and are also traded on other principal stock exchanges throughout the world.

Subsidiaries: The company has two major subsidiaries engaged in marketing and research activities -- The International Nickel Company, Inc. based in the United States and International Nickel Limited in the United Kingdom. International Nickel's worldwide family of affiliates includes a number that are marketing-oriented; others specialize in exploration and development and still others produce nickel and nickel-alloy rolling-mill products.

Mines: The company's 11 producing mines are located in the Sudbury District of Ontario -- the free world's principal source of nickel-- and in the Thompson area of northern Manitoba. Eight new mines are under development in Canada, and potential ones are being investigated in several other countries.

PRINCIPAL PROPERTIES, PLANTS AND LABORATORIES

Producing Mines

SUDBURY DISTRICT, ONTARIO - Creighton, Frood-Stobie, Garson, Levack, Murray, Crean Hill, Clarabelle, Maclennan and Totten
THOMPSON DISTRICT, MANITOBA - Thompson and Birchtree

Concentrators

SUDBURY DISTRICT, ONTARIO - Copper Cliff, Creighton, Levack and Frood-Stobie
THOMPSON DISTRICT, MANITOBA - Thompson

Smelters

COPPER CLIFF, ONTARIO - Nickel oxide sinters
CONISTON, ONTARIO
THOMPSON, MANITOBA

Iron Ore Recovery Plant

COPPER CLIFF, ONTARIO - Iron ore; soluble nickel oxide

Refineries

PORT COLBORNE, ONTARIO - Nickel metal, osmium
THOMPSON, MANITOBA - Nickel metal; elemental sulphur
COPPER CLIFF, ONTARIO - Copper; gold, silver, selenium, tellurium; semi-refined platinum-group metals; nickel sulphate
CLYDACH, WALES - Nickel metal (pellet and powder); nickel and cobalt salts and oxides; iron powder
ACTON (LONDON), ENGLAND - Platinum, palladium, rhodium, ruthenium and iridium

Research Laboratories and Pilot Plants

COPPER CLIFF, PORT COLBORNE AND SHERIDAN PARK, ONTARIO
STERLING FOREST, NEW YORK, AND HARBOR ISLAND, NORTH CAROLINA, U.S.A.
BIRMINGHAM AND ACTON (LONDON), ENGLAND, AND CLYDACH, WALES;

Rolling Mills

Plants - HUNTINGTON, WEST VIRGINIA, AND BURNAUGH, KENTUCKY, U.S.A.; HEREFORD, ENGLAND - Wrought nickel and high nickel alloys

Research Laboratories - HUNTINGTON, WEST VIRGINIA, U.S.A.; HEREFORD, ENGLAND

CANADIAN FACILITIES

Ontario Division

This division encompasses the free world's largest nickel mining and refining complex -- a railway- and pipeline-linked network of mines, mills, smelters and other facilities located for the most part within a 30-mile radius of Copper Cliff in the mineral-rich Sudbury District. It also includes an electrolytic nickel refinery and process research stations some 300 miles to the south at Port Colborne.

Persistent efforts to meet increasing manpower needs resulted in further expansion of the Ontario Division. The Division had some 21,000 employees, as of spring 1969, engaged in the productio processing and treatment of nickel.

In the Sudbury District of Ontario, the company presently operates eight underground mines and one open-pit mine. Expansion projects are under way at these producing mines, and at associated processing facilities, including the smelter, electrolytic copper refinery and iron ore recovery plant at Copper Cliff. Additionally, six new mines are under development in Ontario, five in the Sudbury area and the other some 450 air miles to the northwest, where work started on the development of the important new Shebandowan mine near Fort William-Port Arthur (see "Exploration and Development").

Ores from the Sudbury District contain nickel, copper and iron in sulphide form, and other elements. The company's principal reduction plant is at Copper Cliff, a few miles from the city of Sudbury. Its facilities include: a 26,000-ton-per-day concentrator, roasting and reverberatory furnaces, converters, a copper-nickel separation plant and a fluid-bed roaster plant for the production of nickel oxide sinters. Other concentrators are located near the Frood-Stobie, Crieghton and Levack mines; they have daily capacities of 23,000, 12,000 and 6,000 tons of ore, respectively. There is also a smelter at Coniston.

Two oxygen plants with a combined capacity of more than 1,100 tons per day supply the oxygen requirements for the smelting operations.

Nickel concentrates from the Sudbury District are refined at Port Colborne, where pure nickel is produced in cathode form. At Copper Cliff, the company produces the following nickel products: nickel oxide sinters, soluble nickel oxide and nickel sulphate. By-products from the nickel-processing operations include: copper, iron ore, gold, silver, osmium, selenium, tellurium and semi-refined platinum-group metals. The latter are sent to Acton (London), England, for final processing.

An $80,000,000 refinery using the new Inco Pressure Carbonyl process (see "Research") is being built at Copper Cliff. It is scheduled for completion in 1971, and will have an annual capacity of 100 million pounds of nickel in the form of pellets and 25 million pounds of nickel in the form of powders.

At the Copper Cliff iron ore recovery plant, a nickeliferous pyrrhotite is treated by an atmospheric-pressure ammonia leaching process for the recovery of nickel and the production of high-grade iron ore. This plant now has an annual capacity of 900,000 long tons of iron ore pellets containing 68 per cent iron. An expansion project currently under way will increase the plant's capacity by some 30 per cent upon completion in 1970.

Sulphur dioxide from the iron ore recovery plant roasters, and from smelter gases, is supplied to nearby plants of Canadian Industries Limited for the production of sulphuric acid and liquid sulphur dioxide. The capacity of the sulphuric acid facilities at the iron ore recovery plant is 900,000 tons per year. This sulphuric acid complex is one of the world's largest.

Manitoba Division

Four hundred air miles north of Winnipeg, International Nickel's operations at Thompson constitute the free world's first fully integrated nickel mining and refining complex. Commercial production from the Thompson mine and associated processing facilities began in 1961. The Thompson refinery employs a company-developed process for the direct electrorefining of nickel-matte anodes. Elemental sulphur, a copper concentrate and cobalt oxide are by-products of this process. Some 3,700 employees are engaged in production, processing and treatment of nickel ore at the Thompson complex.

The new Birchtree mine, a major addition to the Thompson complex, came into regular production early in 1969. Surface work as well as underground development is under way at the Soab mine in time for projected operations in 1969. At the Pipe mine, which will come into production by late 1971, dredging of overburden for open-pit mining will be completed late in the summer of 1969. Shaft sinking for the underground portion of the mine has been completed. A 48-mile railroad has been completed and will link the Soab and Pipe mines to the Thompson ore-processing complex. A 30-mile railroad spur links the plant area and the adjacent town of Thompson to the Canadian National Railway's Hudson Bay Line, extending from Winnipeg to Churchill.

By the latter part of 1971, the company's Manitoba facilities are expected to have an annual production capability of 170,000,000 pounds of nickel.

UNITED KINGDOM REFINERIES

International Nickel's highly automated refinery at Clydach, Wales, is the largest in Western Europe, and one of the most technologically advanced nickel refineries in the world. In addition to pure nickel pellets, its products include: nickel powder, iron powder and a wide range of salts and oxides of nickel and cobalt.

At Acton, semi-refined platinum-group metals from Canada are treated to recover pure platinum, palladium, rhodium, ruthenium and iridium.

RESEARCH AND DEVELOPMENT

International Nickel maintains extensive metallurgical research facilities in Canada, the United States and the United Kingdom. The hub of its process metallurgy activities is the J. Roy Gordon Research Laboratory in Sheridan Park, near Toronto. Other process research facilities are located at Port Colborne, Thompson and Copper Cliff in Canada, and at Clydach, Wales.

The two principal product research laboratories are the Paul D. Merica Research Laboratory, Sterling Forest, New York, and the Birmingham Research Laboratory, Birmingham, England. Both specialize in research on alloys of nickel. Nickel-containing alloys and other manufacturing materials are tested in natural marine environments at International Nickel's newly-renamed Francis L. LaQue Corrosion Laboratory, near Wrightsville Beach, North Carolina.

The Birmingham Research Laboratory now includes a section devoted to product research on the platinum-group metals and their alloys, which was formerly based at Acton. In April, 1969, an extensive program for modernization of research accommodations at the Birmingham Laboratory was announced. It is scheduled to be completed in 1971.

MARKETING

International Nickel has a worldwide marketing organization with central sales and marketing offices in Toronto, New York and London. In the United States, marketing functions are carried out on a local level by district offices of The International Nickel Company, Inc. Marketing activities directed from London are supported by affiliates in Australia, Belgium, France, India, Italy, South Africa, Spain, Sweden, Switzerland and West Germany.

ROLLING MILL DIVISIONS

Rolling mills for the production of nickel and nickel alloys are operated by the Huntington Alloy Products Division of The International Nickel Company, Inc. at Huntington, West Virginia, and Burnaugh, Kentucky, and by a wholly-owned affiliate of International Nickel Limited, Henry Wiggin & Company, Limited, Hereford, England.

The $30,000,000 expansion program at the Huntington Division's Burnaugh plant site is well advanced. The new vacuum induction melting facilities are expected to be operational in 1969, while production of extruded products is anticipated late in 1970.

Construction of new merchant mill facilities at the Huntington plant is currently under way. First production of hot-rolled wire rod is expected during the second half of 1970.

The Huntington Division and Henry Wiggin have independent marketing and research staffs and facilities. A subsidiary company, Nickel Alloys International S.A., with headquarters in Brussels, markets Huntington and Henry Wiggin products throughout Continental Europe. Australasian Nickel Alloys, a division of International Nickel (Australasia) Proprietary Limited, Melbourne, also markets these products.

Deliveries of nickel products by the company's rolling mill divisions in the United States and the United Kingdom totaled 96,790,000 pounds in 1968, compared with 95,860,000 pounds in the previous year.

NICKEL

Nickel is used mainly as an alloying element. But it does have a number of important applications in the unalloyed state, particularly as a plating material. It lends strength, toughness, corrosion resistance and other critical engineering properties to thousands of alloys.

Even before it was recognized as a separate element, nickel, by virtue of its versatility and compatibility, had become vital to human progress. Implements containing nickel are known to have been used as far back as 5,000 years ago in Mesopotamia and Sumeria; while in 1969 the Apollo 9 manned space capsule made use of nickel alloys to withstand the effects of exposure to high temperatures, dynamic and acoustical stress, and fatigue.

Nickel was identified and isolated as a separate element in the 18th century by the Swedish scientist Axel F. Cronstedt, also credited for having given it its name. The metal had been previously known to the miners of Saxony as "kupfernickel" or "Old Nick's copper." Thus the name "nickel."

Since 1905, Canada has been the world's largest producer of nickel. Nickel ores are also mined in New Caledonia, the United States, Australia, Finland, South Africa, Greece, Latin America, the Soviet Union and Cuba.

It was in 1905 that the original MONEL* nickel-copper alloy (now designated MONEL alloy 400), with its excellent corrosion-resistant properties, was developed. As the first nickel-base alloy to gain widespread commercial acceptance, it did much to demonstrate the advantages of nickel in alloyed form.

Stainless steels are by far the largest alloying market for nickel. They are noted for their corrosion resistance, strength, toughness and appearance. Other major uses of nickel are in electroplating for appearance and corrosion resistance, and in high-nickel alloys (widely used in jet engines) for high-temperature strength. Nickel also adds strength and toughness to constructional steels and to iron and steel castings. Copper and brass products containing nickel are widely used in marine applications.

*International Nickel Trademark

ESTIMATED FREE WORLD NICKEL CONSUMPTION BY MAJOR FIELDS OF APPLICATION

Field	Estimated Millions of Pounds 1968		1967	
Stainless Steels	307	37%	300	37%
Nickel Plating	124	15%	122	15%
High-Nickel Alloys	119	14%	114	14%
Constructional Alloy Steels	91	11%	87	11%
Iron & Steel Castings	81	10%	86	11%
Copper & Brass Products	27	3%	31	4%
All Others	81	10%	70	8%
Free World Total	830	100%	810	100%

Free world consumption of nickel by major consuming areas, according to estimates made early in 1969, followed traditional patterns. The United States remains the leading nickel consuming nation (340 million pounds in 1968). Continental Europe and the United Kingdom consumed 317 million pounds; Japan, 129 million pounds; Canada, 25 million pounds; and other free world countries, 19 million pounds.

PRIMARY NICKEL PRODUCTS

To satisfy the diverse raw material requirements of its customers, International Nickel supplies primary nickel in a variety of useful forms. The most widely consumed is electrolytically refined nickel produced at the organization's Canadian refineries. This is available to customers in a variety of standard sizes, accommodating all types and sizes of melting furnaces and plating baskets. A special form of electrolytic nickel with sulphur added in small, controlled quantities is also produced specifically for use as an anode material by the plating industry.

Another important primary nickel product, widely used throughout Europe for alloying, is the nickel pellet. At International Nickel's refinery in Clydach, Wales, nickel pellets are produced by means of the carbonyl process in which nickel is separated from impurities by being transformed to a gaseous state and then back to a solid.

Nickel oxide sinter, an economical primary nickel product, is especially useful in the manufacture of stainless steel and other nickel alloy steels. This dense, granular product is available in two forms, containing 90 and 75 per cent nickel. It is packaged in steel drums designed for direct charging into open hearth, basic oxygen, electric arc and induction furnaces.

Nickel powders for powder metallurgy and other uses are also produced by International Nickel, as are oxides and salts of nickel for a variety of applications in the chemical process industries.

COPPER

International Nickel ranks among the major free-world copper producers. This metal is found in substantial quantity in many of the nickel-containing ores the company mines.

Blister copper from the Copper Cliff smelter is refined by the copper refining division, formerly a subsidiary known as Ontario Refining Company Limited. From this name is derived the registered brand and trademark ORC, identifying the various products of the refinery, which include cathodes, wire bars, billets, cakes and other shapes convenient for copper and copper alloy fabrication. Most ORC brand copper is marketed in Canada and Europe.

PLATINUM-GROUP METALS

International Nickel is also one of the world's leading producers of the platinum-group metals -- platinum, palladium, rhodium, ruthenium, iridium and osmium.

Principal uses of the platinum-group metals are industrial. Initial cost is often more than offset by their extraordinary properties, long service life and high recovery value. Characteristics that make them important to industry include: resistance to oxidation and corrosion, peak catalytic activity, and high melting points.

The platinum-group metals, notably platinum, palladium and rhodium, are also used in jewelry and the decorative arts.

Platinum

Most plentiful of the group. Used as catalyst in the petroleum and chemical industries. Excellent resistance to corrosion and oxidation at elevated temperatures.

Palladium

Widely used for electrical contacts. Also serves as catalyst in synthesis of organic compounds requiring hydrogenation or dehyrogenation for such products as vitamins and antibiotics. Palladium-containing brazing alloys offer exceptional combinations of properties for metal-to-metal joining at temperatures as high as 2260 degrees F.

Rhodium, Ruthenium Iridium, Osmium

Principally used as alloying additions to platinum or palladium, frequently as hardeners. Rhodium in the electroplated form is used in a variety of contact applications in the electrical and electronic industries. Current uses for osmium are principally in the chemical area.

INTERNATIONAL NICKEL'S DELIVERIES OF NICKEL, COPPER AND PLATINUM-GROUP METALS AND GOLD (1959 - 1968)

Year	Nickel* (Pounds)	Copper* (Pounds)	Platinum-Group (Troy Ounces)
1968	480,800,000	314,200,000	440,900
1967	463,500,000	310,900,000	475,600
1966	500,200,000	293,000,000	500,900
1965	493,000,000	275,900,000	510,800
1964	444,200,000	286,500,000	544,800
1963	350,700,000	253,600,000	439,400
1962	318,200,000	267,300,000	410,800
1961	372,500,000	268,700,000	443,000
1960	351,900,000	292,500,000	409,400
1959	317,000,000	252,500,000	420,900

*Nickel and copper figures are rounded to nearest hundred thousand pounds.

TEN-YEAR REVIEW OF FINANCIAL RESULTS (1959-1968)

(Figures to nearest hundred thousand, except earnings and dividends-per-share. All figures expressed in U. S. currency.)

Year	Net Earnings	Net Earnings* Per Common Share	Common Dividends
1968	$143,700,000	$1.93	$91,500,000
1967	141,800,000	1.90	89,100,000
1966	118,200,000	1.59	83,100,000
1965	143,800,000	1.94	90,300,000
1964	135,800,000	1.84	81,300,000
1963	106,300,000	1.44	66,300,000
1962	94,200,000	1.28	55,900,000
1961	88,800,000	1.21	46,900,000
1960	80,700,000	1.10	44,500,000
1959	85,200,000	1.16	43,800,000

Year	Dividends* Per Common Share	Capital Expenditures	Exploration Expenditures	Income Taxes
1968	$1.23	$175,400,000	$17,000,000	$86,800,000
1967	1.20	$145,700,000	13,300,000	78,300,000
1966	1.12	73,000,000	11,700,000	69,000,000
1965	1.22	62,700,000	12,300,000	93,500,000
1964	1.10	44,400,000	7,600,000	66,700,000
1963	0.90	36,000,000	6,400,000	43,600,000
1962	0.76	61,000,000	5,900,000	37,400,000
1961	0.64	46,000,000	7,400,000	60,900,000
1960	0.61	76,000,000	8,900,000	60,200,000
1959	0.60	66,900,000	8,000,000	58,800,000

*As adjusted to reflect the split of the shares on a 2-for-1 basis in 1960 and on a 2½-for-1 basis in 1968.

SHARES AND SHAREHOLDERS

As of March 24, 1969, there were 74,396,486 shares and 79,636 shareholders. Records of shareholder addresses showed almost 55% of the shareholders to be in Canada, 42% in the United States and 3% elsewhere; and some 29% of the shares to be held by those in Canada, some 56% in the United States and about 15% in the rest of the world.

EXTERNAL FINANCING

To add to its general funds for application to its capital expenditure program, the company, on March 28,1968, sold $150,000,000 of 6.85 per cent debentures due in 1993.

In June 1968, the company's United States subsidiary, The International Nickel Company, Inc., to help finance its capital expenditures and to augment working capital, arranged a $75,000,000 revolving credit with a group of United States and Canadian banks.

In September and October, 1968, another subsidiary, International Nickel Projects Limited, borrowed a total of Swiss Francs 70,000,000 ($16,300,000).

INCO'S CONTRIBUTION TO THE CANADIAN ECONOMY IN 1968

As the world's largest producer of nickel, International Nickel has developed markets in many countries. Through exports and purchases of supplies and services, International Nickel makes a significant contribution to Canada's economy. Details of some of these for 1968 follow:

Employees: The company employs some 24,400 people in Canada, Over 80,000 Canadians derive their livelihood, directly or indirectly, from International Nickel's operations.

Wages and Salaries: The company paid over $190,000,000 to employees in Canada.

Capital Outlay: The company spent over $150,000,000 for capital projects in Canada.

Exploration: Some $13,000,000 was expended in the search for new mineral deposits in Canada.

Purchases: In addition to capital outlays about $160,000,000 was spent in Canada for goods and services relating to metal production.

Foreign Exchange: International Nickel's activities contributed approximately $550,000,000 to Canada's balance of international payments. Of this amount some $145,000,000 was attributable to the sale in 1968 of debentures due 1993.

Dividends: Canadian shareholders received over $27,000,000 in dividends. The market value of the company's shares held by Canadians, as of November 20, 1968, totaled over $800,000,000.

* All figures in Canadian funds

EXPLORATION

International Nickel conducts exploration throughout Canada and in various parts of the world. In recent years, as the organization's search for nickel has intensified, its prospecting teams have been flying almost a million miles annually. Their techniques include aerial geophysics and photography; ground geology, geophysics and geochemistry; and soil and rock sampling using a wide variety of equipment.

In the last 10 years, the company has spent over \$100,000,000 in its search for new nickel sources, including a record \$17,000,000 in 1968. Approximately 70 per cent of the exploration expenditures last year was made in Canada.

In addition to the company's continuing underground exploration projects in the Sudbury District of Ontario and Thompson area of Manitoba, both at producing mines and those under development, extensive surface exploration programs are conducted in other parts of Canada by a wholly-owned subsidiary, Canadian Nickel Company Limited. Last year, exploration was maintained at a high rate in Ontario, Manitoba, Quebec and Saskatchewan. At Shebandowan, underground exploration continued, while in the Sudbury District, an exploratory shaft was completed for investigation of low-grade nickel mineralization in the North Range area.

Canadian sulphide ores will be the mainstay of free-world nickel production for the foreseeable future, and production of nickel in Canada will continue to grow. However, a very significant proportion of the world's potential nickel reserves is contained in lateritic deposits. International Nickel is actively involved in exploring for or developing lateritic deposits in Guatemala, Indonesia, New Caledonia, the British Solomon Islands and Australia. At the same time, it is investigating or developing sulphide deposits in the United States, Australia and elsewhere, as well as Canada.

Included among its exploration and development subsidiaries outside of Canada are International Nickel Southern Exploration Limited (INSEL), based in Australia; Exploraciones y Explotaciones Mineras Izabal, S.A. (Exmibal) in Guatemala; and P.T. International Nickel Indonesia. The first-mentioned has acquired exploration rights to a number of areas in Australia and is also exploring in the British Solomon Islands. Exmibal is preparing to develop lateritic nickel deposits near Lake Izabal in Guatemala, while the subsidiary in Indonesia is conducting extensive survey and exploration work on the island of Sulawesi.

NEW MINE DEVELOPMENT IN CANADA

By 1972, International Nickel is scheduled to have eight new mines in production in Canada. This is part of the largest expansion program in the history of the company; it also involves expansions at most of the 11 producing mines in Ontario and Manitoba, and at associated processing facilities. As a result, the company's annual Canadian nickel-production capability will progressively increase and surpass 600,000,000 pounds by the latter part of 1971 -- an increase of some 150,000,000 pounds, or 30 per cent, above the current capability. When this expansion program is completed, International Nickel will have 19 mines in Canada, with production rates ranging from 1,000 to more than 30,000 tons of ore per day.

Ontario. Six of the eight new mines will be in Ontario. In the Sudbury District, Little Stobie and Kirkwood mines are scheduled for production in 1969. Production at the Coleman mine will begin in early 1970. The Copper Cliff North mine will be in full production that year. The Copper Cliff South mine is expected to reach the production stage in 1971.

At the southwest corner of Shebandowan Lake in north-western Ontario, about 50 miles west of Fort William and Port Arthur, the sixth new Ontario mine is being developed. The Shebandowan production shaft will be sunk to a depth of 2,375 feet on the south shoreline of the lake; a concentrator will be constructed about a quarter of a mile from the mine's headframe. Production is scheduled for 1972, at 2,900 tons of ore per day.

Manitoba: The new Birchtree mine came into regular production early in 1969. Surface work and shaft sinking went forward at the Soab mine, which will be in production in 1969. The Pipe mine is scheduled to come into production in late 1971.

POTENTIAL OPERATIONS OUTSIDE OF CANADA

Guatemala: Upon the conclusion of necessary arrangements with the Guatemalan Government, International Nickel's majority-owned subsidiary, Exploraciones y Explotaciones Mineras Izabal, S.A. (Exmibal), will begin large-scale construction of nickel mining and processing facilities near Lake Izabal in northeastern Guatemala. The construction, which will take fully three years, will employ as many as 2,000 Guatemalans during peak periods, and bring total investment in the project to an estimated $180,000,000. The Exmibal project, one of the first major mining operations in Central America, involves the establishment of facilities for the production, from lateritic ores, of at least 50,000,000 pounds of nickel in nickel-containing products.

New Caledonia: In March 1969, International Nickel entered into an agreement with a group of French industrial, financial and government interests establishing a new French mining company to develop the nickel ore deposits of New Caledonia. The company, Compagnie Francaise Industrielle et Miniere du Pacifique (Cofimpac), will be the second company to produce nickel in the French overseas territory. Upon favorable completion of the feasibility study presently underway, Cofimpac would construct facilities capable of producing up to 100,000,000 pounds of nickel annually from lateritic ores. Total expenditures through the initial production phase could exceed $200,000,000.

Indonesia: In July 1968, International Nickel entered into an agreement with the Republic of Indonesia under which a major nickel-producing project could be established on the island of Sulawesi. P. T. International Nickel Indonesia, a company formed under the laws of Indonesia, is now exploring and, if economic, will develop nickel deposits on the island.

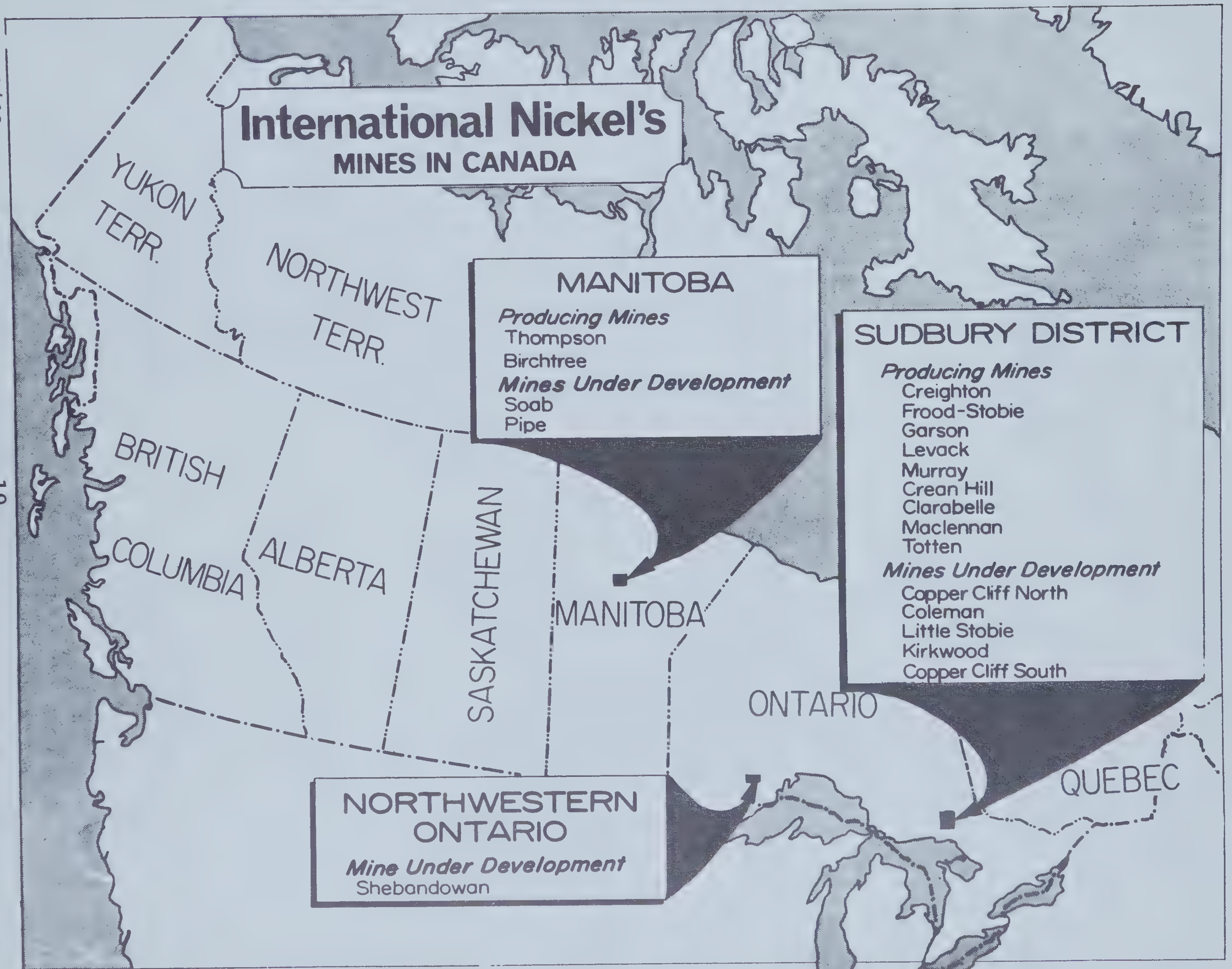
United States: Near Ely, Minnesota, The International Nickel Company, Inc. has completed sinking of a shaft to determine mining costs and to extract bulk ore samples, which are being tested in furtherance of the company's efforts to develop this low-grade copper-nickel deposit.

South Pacific: Much exploration is being carried out in the South Pacific area. In Western Australia, International Nickel, in participation with The Broken Hill Proprietary Company Limited, has encountered sulphide mineralization in the Kalgoorlie area, but commercial tonnage has not been outlined to date. The commercial status of lateritic deposits at Wingellina, Western Australia, and at Rockhampton, Queensland, continues to be evaluated. Exploration and property examinations are also being carried out in the British Solomon Islands Protectorate, New Zealand, Papua and New Guinea.

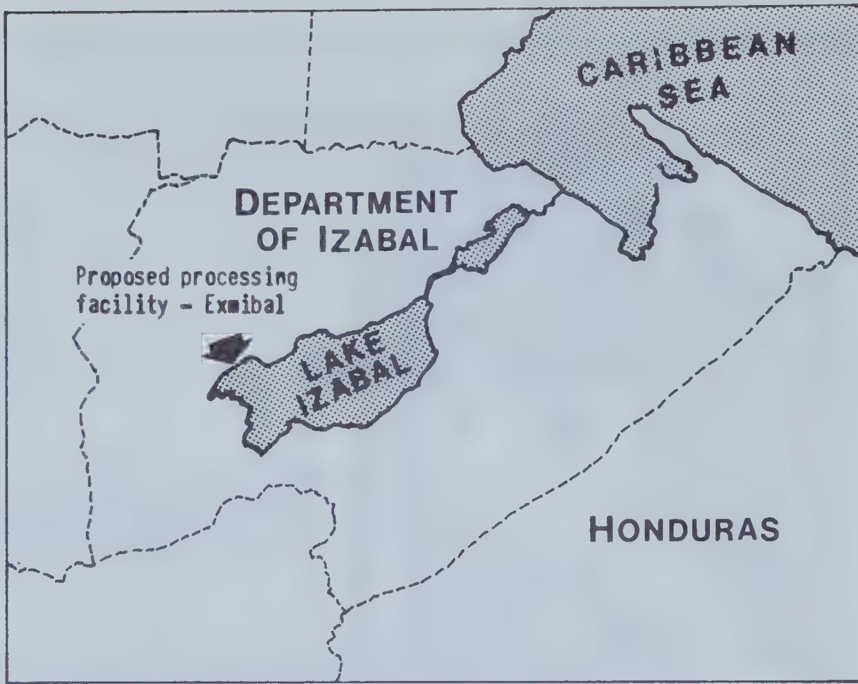
Central America: International Nickel has been carrying out general exploration in Guatemala, Panama, Costa Rica and elsewhere.

South Africa: In 1968, the company acquired a 10 per cent interest in Impala Platinum Limited (an affiliate of the Union Corporation Limited), which is building a new platinum-group metals mining, smelting and refining establishment in South Africa. International Nickel is providing technical assistance on the platinum refining aspects of the projects. Production of platinum is scheduled to begin at an initial rate of 100,000 troy ounces per year.

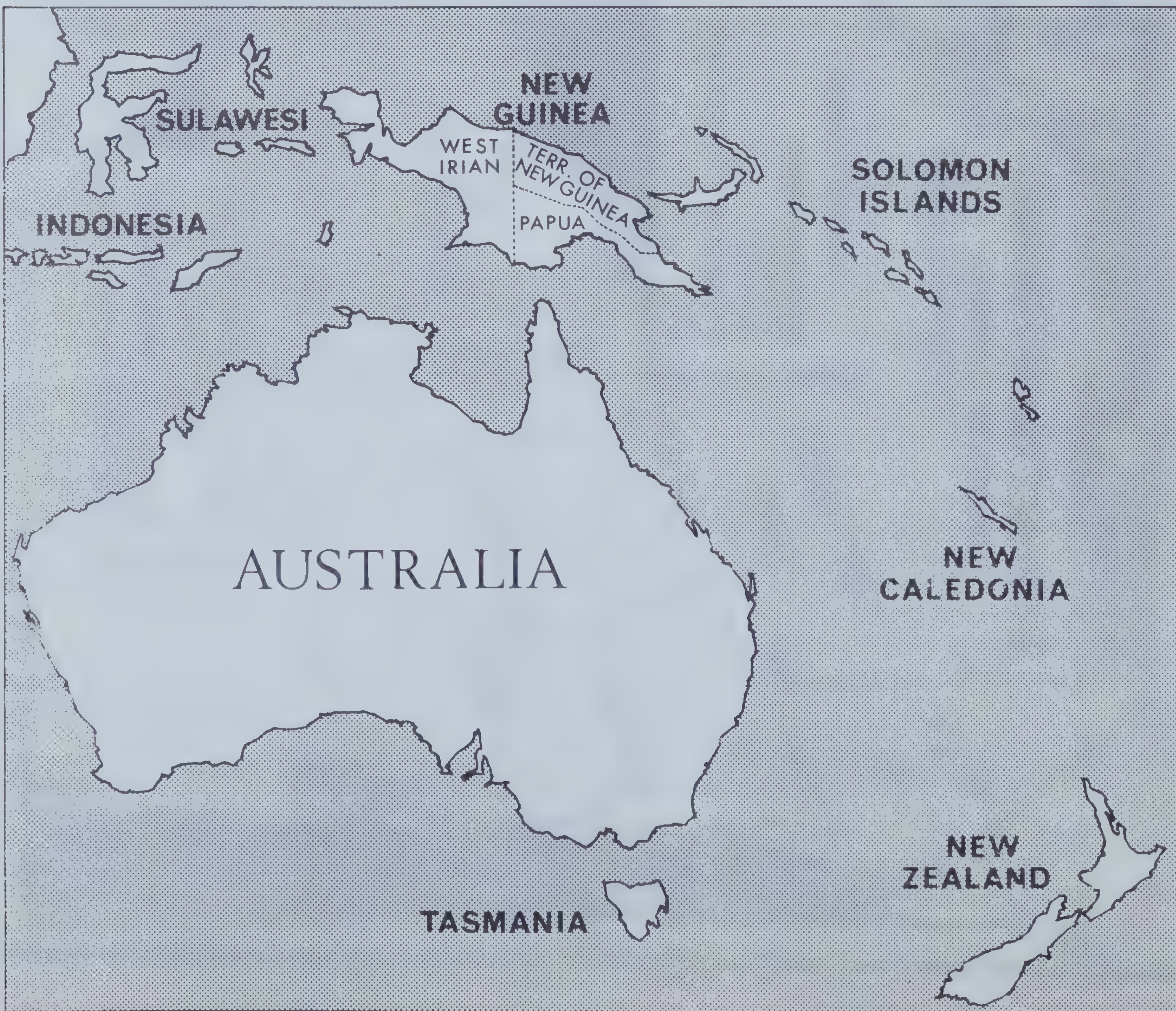
Other Mining Projects: In Canada, underground work will proceed in 1969 that may result in the development of a new mine at Victoria in the Sudbury District, where an old mine was last worked in 1923. An estimated 100,000,000 gallons of water will be pumped out of the former mine site to permit investigation below the old workings. Another prospect is in the North Range area, also in the Sudbury District, where an exploration shaft was completed in 1968 to its planned depth of 3,175 feet.


International Nickel's
MINES IN CANADA
YUKON TERR.
NORTHWEST TERR.
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
MANITOBA
Producing Mines
Thompson
Birchtree
Mines Under Development
Soab
Pipe
SUDBURY DISTRICT
Producing Mines
Creighton
Frood-Stobie
Garson
Levack
Murray
Crean Hill
Clarabelle
Maclennan
Totten
Mines Under Development
Copper Cliff North
Coleman
Little Stobie
Kirkwood
Copper Cliff South
NORTHWESTERN ONTARIO
Mine Under Development
Shebandowan

Upon conclusion of arrangements with the Guatemalan Government, Inco's majority-owned subsidiary, Exmibal, will begin construction of nickel mining and processing facilities near Lake Izabal in northeastern Guatemala.



Inco's exploration efforts outside Canada are centered in the Pacific, notably in New Guinea, Papua, Solomon Islands, Australia and New Zealand. In New Caledonia, COFIMPAC, a new company formed by Inco and a group of French interests, is conducting a feasibility study prior to setting up a nickel-producing operation. In Indonesia, on the Island of Sulawesi, P. T. International Nickel Indonesia is currently carrying out a field exploration program in its concession area.



RESEARCH AT INTERNATIONAL NICKEL

International Nickel is engaged in three basic areas of research: mining research to develop improved methods of recovering nickel-containing ores; process research to seek more efficient means of recovering the metal from the ore; and product research, which concentrates on new commercial applications for nickel. A fourth area, also of great importance, is research in environmental control.

Mining Research

Mining engineers and geologists at International Nickel are continually seeking ore-recovery methods that will enable miners to work ore bodies faster, more efficiently and to greater depths.

Much of the company's ore production in the Sudbury District of Ontario is derived from fill methods of mining, necessitating that mined-out sections be supported as ore removal proceeds. The company-developed method of cemented sand fill -- replacing the traditional crushed rock and gravel -- has enabled the fill method of mining to be carried on at deeper locations and with greater efficiency than before.

More recently, with the development of diesel-powered trackless mining equipment furnished with oxy-catalytic exhaust scrubbers, the company introduced underground ramp mining at the Creighton mine in the Sudbury District. This innovation, which is also being adopted wherever practicable in other company mines, is expediting the recovery of low-grade nickel ore that was once considered valueless, but is now economically feasible to mine because of improved processing and mining methods.

Process Research

The growing dependence of nickel producers on lower-grade sulphide and lateritic ores has resulted in major research efforts toward more efficient processes of extracting the nickel and other metals. International Nickel's most recent innovation in the treatment of sulphide concentrates and metallurgical intermediates is the Inco Pressure Carbonyl (IPC) process integrating pyrometallurgical, vapometallurgical and hydrometallurgical techniques. This process will be commercially implemented at the new $80 million nickel pellet and powder refinery now being constructed at Copper Cliff.

Lateritic ores to be mined at the company's proposed operations in Guatemala will be treated by a pyrometallurgical process developed by International Nickel specifically for ores of this type. Similarly, the company's joint venture with French partners in New Caledonia will rely on processes developed and/or proven out at International Nickel's laboratories and pilot plants. Special attention is also being given to the ores of Minnesota, Indonesia and Australia.

International Nickel's process research activities are headquartered at the J. Roy Gordon Research Laboratory in Sheridan Park, near Toronto. The principal function of this laboratory is to continue the development of fundamental information that will lead to new and improved processes for all types of nickel ore. In addition, work is directed toward development of new forms of nickel and associated elements.

The activities at the J. Roy Gordon Research Laboratory are combined with those at three process research stations at Port Colborne, Ontario, to greatly speed the transition of new extractive metallurgy concepts from laboratory investigation to commercial realization.

Product Research

International Nickel's product research serves to broaden the range of commercial applications for nickel by creating marketable nickel-containing materials, by improving existing ones, by developing treatments that modify nickel alloy properties, and by demonstrating the suitability of nickel-containing materials for specific functions. Research activities are influenced by the present and anticipated needs of industry as uncovered by the company's men in the field, and by product development and application engineers.

Two recent results of International Nickel's product research are a new, high-strength structural stainless steel and a high-strength copper-base alloy. The former, a forerunner of a whole new family of alloys, is also superplastic at high temperatures; the latter is expected to fill an important need for high-pressure seawater piping and ultimately to find use as a deep-sea structural material.

International Nickel's major product research facilities are the Paul D. Merica Research Laboratory in Sterling Forest, New York and the Birmingham Research Laboratory in Birmingham, England.

Corrosion studies in these laboratories are supplemented by tests of metallic and non-metallic materials conducted under carefully monitored and controlled conditions in both natural and modified marine environments at the Francis L. LaQue Corrosion Laboratory, located on the coast of North Carolina near Wilmington. Testing has been carried out in this location for more than three decades, and the data accumulated form a substantial part of International Nickel's file of more than 300,000 laboratory and in-service test results relating to the performance of materials in corrosive environments.

Environmental Control

International Nickel is devoting substantial research effort -- both alone and with outside specialists -- to improving environmental conditions where it operates. Attention has been centered principally on air, water, soil and noise pollution control. In the first instance, improvements in refining and recovery operations have contributed substantially to the reduction of offensive elements vented to the atmosphere. These, coupled with modern dust-collection equipment, have played an important part in the company's clean air program. One of the most significant steps forward was the decision to build a 1,250-foot chimney -- the world's tallest -- at Copper Cliff, which will assure that the air in the Sudbury District will be cleaner than that of any other industrial urban community in Ontario.

Indicative of the progress in conserving water is the fact that despite increased water needs as a result of expansion, the company in the Sudbury area is drawing the same amount of water as in 1964. Recycling, clarification, neutralization and sewage treatment facilities already installed and being planned at all company facilities will ensure that water discharged into natural water courses will not contaminate them.

The company's mine-tailings dumps are now being successfully planted with grasses as a result of an extensive research project to grow "rye on the rocks." As of 1969, some 600 acres have been treated with the new process, which slowly returns the barren, sterile dumps to self-supporting grasslands that attract wildlife or will someday be able to be farmed.

Recognizing that excessive noise is both dangerous to health and detrimental to production, International Nickel is combating noise at its mining operations with a hearing conservation program that is rapidly approaching full implementation. The program includes reducing noise at its source, erecting abatement barriers, requiring employees to wear protective hearing equipment, an education program designed to alert personnel to the dangers of industrial noise, medical examinations and remedial treatments.

MARKETING ORGANIZATION

International Nickel's marketing activities for primary nickel extend to all parts of the free world and encompass nearly every field of industrial activity. Broadly speaking, they entail research and development of nickel-containing materials, expansion of nickel applications and markets, and the sale of nickel. Within the marketing organization, product research is closely coordinated with market development and sales. These activities are supported by market research as well as advertising, publicity and market promotion programs.

Market development at International Nickel begins with delineation of the benefits that nickel-containing materials contribute to markets through particular product applications. These advantages are presented to the designers, manufacturers and users of metal products by direct discussion and published literature, and through technical and trade societies. The company's application engineers help manufacturers adapt materials to their own design and fabrication methods.

MAJOR MARKET DEVELOPMENT ACTIVITIES

Market development at International Nickel is based on industry applications for nickel. The company's Market Development Department is staffed with application engineers who are specialists in the utilization of materials in broad industrial fields including:

- Aerospace
- Architecture
- Automotive
- Chemical
- Civil Engineering and Construction
- Consumer Products
- Electronics
- Marine
- Petroleum
- Power
- Process (food, water, environmental control)
- Transportation and General Machinery

WORLDWIDE MARKETING NETWORK

Canada

THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED

United States

THE INTERNATIONAL NICKEL COMPANY, INC.
Huntington Alloy Products Division - Huntington, West Virginia

United Kingdom

INTERNATIONAL NICKEL LIMITED
Henry Wiggin & Company, Limited - Hereford, England

Other Countries

AUSTRALIA	International Nickel (Australasia) Proprietary Limited - Melbourne
	Australasian Nickel Alloys, Division of International Nickel (Australasia) Proprietary Limited - Melbourne
BELGIUM	International Nickel Benelux S.A. - Brussels
	Nickel Alloys International S.A. - Brussels
FRANCE	International Nickel France S.A. - Paris
INDIA	International Nickel (India) Private Limited - Bombay
ITALY	International Nickel Italia S.p.A. - Milan

SOUTH AFRICA	International Nickel S.A. (Proprietary) Limited - Johannesburg
SPAIN	International Nickel Iberica Limited - Madrid
SWEDEN	International Nickel (Nordiska) Aktiebolag - Stockholm
SWITZERLAND	International Nickel A.G. - Zurich
WEST GERMANY	International Nickel Deutschland G.m.b.H. - Dusseldorf

Distributor Information Office

JAPAN	Japan Nickel Information Center - Tokyo

INTERNATIONAL NICKEL OFFICES IN THE UNITED STATES

THE INTERNATIONAL NICKEL COMPANY, INC. - New York, New York

District Offices

Chicago, Illinois
Cleveland, Ohio
Dayton, Ohio
Detroit, Michigan
Hartford, Connecticut
Houston, Texas
Los Angeles, California
New York, New York
Pittsburgh, Pennsylvania
Washington, D.C.
Wilmington, Delaware

Huntington Alloy Products Division - Huntington, West Virginia

Division Sales Offices

Atlanta, Georgia
Bloomfield, Connecticut
Buffalo, New York
Chicago, Illinois
Cincinnati, Ohio
Cleveland, Ohio
Detroit, Michigan
Glendale, California
Houston, Texas
Huntington, West Virginia
Natick, Massachusetts
Pittsburgh, Pennsylvania
San Francisco, California
Seattle, Washington
St. Louis, Missouri
Union, New Jersey
Wilmington, Delaware

THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED

OFFICERS

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HENRY S. WINGATE

President
ALBERT P. GAGNEBIN

Senior Executive Vice President
JAMES C. PARLEE

Executive Vice President
RICHARD A. CABELL

Executive Vice President
F. FOSTER TODD

Assistants to the Chairman
PAUL QUENEAU

ASHBY McC. SUTHERLAND

JOHN H. PAGE

Assistant to the President
DEAN D. RAMSTAD

Vice Presidents
JOHN A. MARSH

L. EDWARD GRUBB

H. FRANKLIN ZURBRIGG

JOHN O. HITCHCOCK

WILLIAM STEVEN

LOUIS S. RENZONI

GLENN H. CURTIS

Vice President - Finance
CHARLES F. BAIRD

Secretary
WILLIAM F. KENNEDY

Comptroller
WALTER A. McCADDEN

Treasurer
F. M. A. NOBLET

DIRECTORS

Term Expires 1970

WILLIAM C. BOLENIUS..Cutchogue, N.Y.
NORRIS R. CRUMP.......Montreal, P.Q.
ALBERT P. GAGNEBIN..Fair Haven, N.J.
JAMES H. GOSS........Cleveland, Ohio
ALLEN T. LAMBERT.......Toronto, Ont.
DONALD H. McLAUGHLIN..San Francisco, Calif.
JAMES C. PARLEE.....Bronxville, N.Y.
ELLMORE C. PATTERSON...Bedford, N.Y.
GEORGE T. RICHARDSON..Winnipeg, Man.
LUCIEN G. ROLLAND.....Montreal, P.Q.
IVOR D. SIMS..........Bethlehem, Pa.
R. EWART STAVERT......Montreal, P.Q.
HENRY S. WINGATE......New York, N.Y.

Term Expires 1971

JOHN J. DEUTSCH..........Kingston, Ont.
Hon. LEWIS W. DOUGLAS..Sonoita, Arizona
J. ROY GORDON......New Fairfield, Conn.
G. ARNOLD HART, M.B.E....Montreal, P.Q.
J.K. JAMIESON..........Mamaroneck, N.Y.
R. SAMUEL McLAUGHLIN......Oshawa, Ont.
H.C.F. MOCKRIDGE, Q.C.....Toronto, Ont.
THE RT. HON. LORD NELSON OF STAFFORD London, England
SIR RONALD L. PRAIN, O.B.E......Lusaka, Zambia
GEORGE C. SHARP...........Katonah, N.Y.
THE RT. HON. VISCOUNT WEIR, C.B.E. Glasgow, Scotland
SAMUEL H. WOOLLEY...Morris Plains, N.J.

EXECUTIVE COMMITTEE

HENRY S. WINGATE, Chairman

J. ROY GORDON
H.C.F. MOCKRIDGE, Q.C.
G. ARNOLD HART, M.B.E.
ELLMORE C. PATTERSON
ALBERT P. GAGNEBIN

ADVISORY COMMITTEE

R. SAMUEL McLAUGHLIN, Chairman

LANCE H. COOPER, M.B.E.
SIR OTTO E. NIEMEYER, G.B.E., K.C.B.
J. ROY GORDON
J. C. TRAPHAGEN
H. R. MacMILLAN, C.B.E.
HENRY S. WINGATE
ALBERT P. GAGNEBIN

HENRY S. WINGATE

Chairman and Chief Officer
The International Nickel Company of Canada, Limited
The International Nickel Company, Inc.

Henry S. Wingate has been chairman of the board of directors and chief officer of The International Nickel Company of Canada, Limited and its United States subsidiary, The International Nickel Company, Inc., since 1960. Prior to this he had been president of both companies since 1954.

Mr. Wingate is chairman of the executive committee and a member of the advisory committee of the parent company, chairman of the executive committee of The International Nickel Company, Inc., and a director of a number of other International Nickel subsidiaries.

Mr. Wingate joined The International Nickel Company of Canada, Limited in 1935 as assistant secretary and as assistant to the president of its United States subsidiary. His association with International Nickel began in 1930 while he was on the staff of its general counsel, the firm of Sullivan & Cromwell. He was elected secretary of the parent company in 1939, a director in 1942 and vice president in 1949.

In Canada, Mr. Wingate is a director of the Bank of Montreal and of the Canadian Pacific Railway Company; and in the United States, a director of J. P. Morgan & Company, Inc., Morgan Guaranty Trust Company of New York, United States Steel Corporation, and American Standard Inc., as well as a trustee of The Seamen's Bank for Savings.

He is a member of The Canadian-American Committee of the National Planning Association, Washington, D. C., and the Private Planning Association of Canada; The Business Council, Washington, D. C.; The Canadian Institute of Mining and Metallurgy; American Institute of Mining, Metallurgical and Petroleum Engineers; Mining and Metallurgical Society of America; the executive committee of American Bureau of Metal Statistics; Council on Foreign Relations, Inc.; Association of the Bar of the City of New York; and a director of The International Copper Research Association, Inc. and of the Societe de Chimie Industrielle, Paris. He is a trustee of the Council for Latin America and the U.S. Council of the International Chamber of Commerce. He is also a member and trustee of the United States Steel Foundation, Inc. and a member of the board of governors of Federal Hall Memorial Associates, Inc.

He is a trustee and senior board member of the National Industrial Conference Board, and a member of its Canadian Council. He is also a trustee of Carleton College, Northfield, Minnesota, and The Annuity Fund for Congregational Ministers and Retirement Fund for Lay Workers, and a member of the Congregational Board of Ministerial Relief.

Mr. Wingate is also a director of the Association for the Aid of Crippled Children; Downtown-Lower Manhattan Association, Inc.; The People's Symphony Concerts; Grand Central Art Galleries; American Committee for the Institute for Advanced Study - Europe, Inc.; Institut des Hautes Etudes Scientifique; and a member of The Pilgrims of the United States; Canadian Society of New York; The Newcomer Society of North America; New York Genealogical & Biographical Society; and Society of Genealogists (London).

A graduate of Northfield High School, Northfield, Minnesota, Mr. Wingate attended Carleton College, receiving a Bachelor of Arts degree in 1927. He received the degree of Juris Doctor from the University of Michigan Law School in 1929. Carleton College presented him with an Alumni Achievement Award in 1956, and in 1957 he received the honorary degree of Doctor of Laws from the University of Manitoba, Winnipeg. During 1967 Mr. Wingate received the University Sesquicentennial Award from the University of Michigan, the honorary degree of Doctor of Laws from Marshall University, Huntington, West Virginia, and the honorary degree of Doctor of Laws from York University, Toronto, Ontario. In 1968 he received the honorary degree of Doctor of Laws from Laurentian University, Sudbury, Ontario.

In September 1967 Mr. Wingate received the International Palladium Medal of the American Section of the Societe de Chimie Industrielle, awarded to "an individual who has distinguished himself by an outstanding contribution to the chemical industry."

Mr. Wingate is a member of the Toronto Club, Toronto; The Mount Royal Club, Montreal; The International Club of Washington, D.C., Inc.; Duquesne Club, Pittsburgh; Laurel Valley Golf Club, Ligonier, Pa.; The Union Club, The Pinnacle Club, University Club, Economic Club, The Recess and City Midday Club (Trustee), all of New York City; and in Long Island, the Huntington Country Club and the Cold Spring Harbor Beach Club.

ALBERT P. GAGNEBIN

President
The International Nickel Company of Canada, Limited
The International Nickel Company, Inc.

Albert P. Gagnebin has been president of The International Nickel Company of Canada, Limited and its United States subsidiary, The International Nickel Company, Inc., since January 1967. He is also a director and member of the executive committee of both companies, a member of the advisory committee of the parent company and a director of a number of International Nickel subsidiaries.

Mr. Gagnebin had been executive vice president of the parent company and its United States subsidiary since 1964. Prior to this, he was vice president of the parent company for four years. He had been elected a vice president of The International Nickel Company, Inc. in 1958.

His association with International Nickel dates from 1930, when he held a summer position at its Huntington Works in West Virginia. In 1932 he joined the staff of the research laboratory of The International Nickel Company, Inc. at Bayonne, New Jersey, engaging in ferrous metals research. A co-inventor of International Nickel's ductile iron, he transferred to the New York office in 1949 to establish a group for the commercial development of this material. In 1955 he was appointed assistant manager of the Nickel Sales Department, becoming manager in 1956.

While on the staff of the Bayonne laboratory, Mr. Gagnebin was concerned with research into factors influencing the toughness of steels at sub-zero temperatures, the effect of deoxidation treatments on the mechanical properties of cast steels, and many studies on cast irons. Over a period of years, he was associated with others in fundamental studies on the solidification characteristics of iron, which eventually led to the discovery of a process for making ductile iron.

Mr. Gagnebin is vice president and director of the Tokyo Nickel Company Limited, Tokyo, Japan; a trustee of the Atlantic Mutual Insurance Company and the Bank of New York; and a director of the Abex Corporation, The Toronto-Dominion Bank, Centennial Insurance Company, Illinois Central Industries, Sterling Forest (N. Y.) Board of Design, International Copper Research Association, Inc., The American Committee for the Institute for Advanced Study - Europe, Inc., American Society for Friendship with Switzerland, Yale Engineering Association and the Albert Gallatin Associates of New York University. He is also a councillor of the French Chamber of Commerce in the United States, Inc., and a member of the Board of Governors of the Canadian Export Association.

Mr. Gagnebin attended Yale University, receiving a Bachelor of Science degree in mechanical engineering in 1930 and a Master of Science degree in metallurgy in 1932.

In May 1952 Mr. Gagnebin and an International Nickel associate were awarded the Peter L. Simpson Gold Medal of the American Foundrymen's Society for their "outstanding work and development in the field of spheroidal cast iron." In July 1965 he was co-recipient of the Annual Award of the Ductile Iron Society "for outstanding contribution to the ductile iron industry and its technology in the field of technical contribution and industry leadership." In October 1967 he was presented with the Grande Medaille d'Honneur of L'Association Technique de Fonderie at the 34th International Foundry Congress. The medal, established in 1932, has only been awarded eight times.

He is an honorary life member of the American Foundrymen's Society; and a member of the American Society for Metals, Mining and Metallurgical Society of America, American Institute of Mining, Metallurgical and Petroleum Engineers, and the Society of Sigma Xi, a scientific fraternity. He is also a member of the Pan American Society of the United States, Woods Hole Oceanographic Institution, The Economic Club of New York; and a resident member of The Mining Club of New York.

He is a member of the Yale Club of New York, The Down Town Association, The Corinthians, and the City Midday Club, all of New York City; and a member of the Rumson Country Club, Rumson, New Jersey; Sea Bright Beach Club, Sea Bright, New Jersey; and the Duquesne Club of Pittsburgh.

JAMES C. PARLEE

Senior Executive Vice President
The International Nickel Company of Canada, Limited
The International Nickel Company, Inc.

James C. Parlee has been senior executive vice president of The International Nickel Company of Canada, Limited since January 1967, and a director since June 1965. He has also been senior executive vice president and a director of the company's United States subsidiary, The International Nickel Company, Inc., since December 1967.

Mr. Parlee had been executive vice president of the parent company since 1964. He was appointed vice president in 1960, and had been in charge of the company's operations in Canada since 1963. Prior to his appointment as assistant vice president in 1958, he worked in various supervisory capacities in the company's Canadian divisions. He joined International Nickel in 1933.

He is a vice president and director of the Canadian Nickel Company, Limited; a director of The Mining Association of Canada; and a director of The National Trust Company, Limited and The Great-West Life Assurance Company.

Mr. Parlee received a Bachelor of Science degree in mining and metallurgy from the University of Alberta, Edmonton, Alberta, in 1933.

He is a member of the Canadian Institute of Mining and Metallurgy and the American Institute of Mining, Metallurgical and Petroleum Engineers, as well as the Association of Professional Engineers in both Ontario and Manitoba.

Mr. Parlee is also a member of the St. Charles Golf and Country Club and the Manitoba Club, Winnipeg; and a member of the Toronto, Toronto Hunt and Toronto Golf Clubs, as well as the York Club, also in Toronto. He is a member of the Boisclair Fish and Game Club of Mattawa, Ontario; the Rideau Club of Ottawa; and the Idylwylde Golf and Country Club of Sudbury. He is also a member of the Siwanoy Country Club, Bronxville, New York, and the City Midday Club and India House, New York City.

RICHARD A. CABELL

Executive Vice President
The International Nickel Company of Canada, Limited
The International Nickel Company, Inc.

Richard A. Cabell has been executive vice president of The International Nickel Company of Canada, Limited since January 1967, and executive vice president of The International Nickel Company, Inc. since April 1964. He has also been a director and member of the executive committee of the United States subsidiary since 1964.

Prior to his present positions, Mr. Cabell had been vice president of the Canadian parent company since 1960. In 1957 he was elected an assistant vice president of The International Nickel Company of Canada, Limited, as well as vice president of The International Nickel Company, Inc. Mr. Cabèll's active association with International Nickel began in 1939 when he joined Sullivan & Cromwell, the company's general counsel. He joined The International Nickel Company, Inc. in 1944 as assistant secretary.

Mr. Cabell received a Bachelor of Arts degree from the University of Virginia in 1935. He attended the University of Virginia Graduate School from 1935 to 1936 and the University of Virginia Law School, receiving a Bachelor of Laws degree in 1939.

Mr. Cabell is a director of The Toronto-Dominion Bank Trust Company and a director as well as chairman of the International Committee of the United States Chamber of Commerce. He is also chairman of the board of the Associated Hospital Service of New York (Greater New York Blue Cross), and a member of the Council on Foreign Relations, New York.

He is a member of the Canadian Club, Broad Street Club, City Midday Club, Economic Club, Knickerbocker Club, Virginians Society and National Arts Club, all of New York; and a member of the University Club and International Club of Washington, D.C.; and the Waccabuc Country Club, Waccabuc, New York.

F. FOSTER TODD

Executive Vice President
The International Nickel Company of Canada, Limited

F. Foster Todd has been executive vice president of The International Nickel Company of Canada, Limited since January 1967.

Mr. Todd was assigned to International Nickel's New York office as assistant vice president in April 1965, and returned to Toronto as executive vice president in charge of Canadian operations in April 1967. Previously he had been assistant vice president of the company since 1964 and general manager of the Manitoba Division since 1962. He joined International Nickel at Copper Cliff in 1929, subsequently serving in various supervisory capacities.

He is a vice president and a director of the Canadian Nickel Company and the Pineland Timber Company, Limited and an officer and director of other International Nickel subsidiaries. Mr. Todd is also a member of the board of directors of The Bank of Nova Scotia.

He received the degrees of Bachelor of Science and Engineer of Mines in 1928 from the Michigan College of Mining and Technology, Houghton, Michigan.

Mr. Todd is a member of the Canadian Institute of Mining and Metallurgy, Mining and Metallurgical Society of America, and American Institute of Mining, Metallurgical and Petroleum Engineers. He is presently a director and vice president of the Mining Association of Canada.

Mr. Todd is also a member of the Canadian Club, Toronto Club, Lambton Golf & Country Club and Granite Club of Toronto; the Copper Cliff Club, Copper Cliff, Ontario; the Manitoba Club, Winnipeg, Manitoba; and the Canadian Club and Mining Club of New York.

CHARLES F. BAIRD

Vice President - Finance
The International Nickel Company of Canada, Limited

and

Vice President - Finance
Director
The International Nickel Company, Inc.

Charles F. Baird joined The International Nickel Company of Canada, Limited as vice president - finance in February 1969. He is vice president - finance and a director of the United States subsidiary, The International Nickel Company, Inc.

Mr. Baird had been Under Secretary of the Navy since August 1967. He joined the Government in November 1965 as Assistant Secretary of the Navy (Financial Management).

Prior to his government service Mr. Baird had been an executive with The Standard Oil Company of New Jersey and its affiliated companies for seventeen years. Starting his career as a financial analyst, he served as Deputy European Financial Representative in London, Financial Director of Esso France in Paris and as Assistant Treasurer of the parent company.

Mr. Baird served as an officer in the Marine Corps in World War II and during the Korean war.

He is a member of The Council on Foreign Relations, The Atlantic Council of the United States, The American Academy of Political and Social Science, Council of Financial Executives of The National Industrial Conference Board and a member of the Chevy Chase Club, Washington, D.C.

L. EDWARD GRUBB

Vice President
The International Nickel Company of Canada, Limited

and

Chairman and Managing Director
International Nickel Limited

and

Chairman
Henry Wiggin and Company Limited

L. Edward Grubb was elected vice president of The International Nickel Company of Canada, Limited and named chairman of the company's United Kingdom subsidiary, International Nickel Limited, in October 1968. He has been managing director of International Nickel Limited since November 1967 and chairman of Henry Wiggin and Company Limited since January 1968.

Mr. Grubb joined the International Nickel organization in 1934, and became general superintendent of the company's Bayonne Works in New Jersey from 1942 until 1953, when he was appointed general superintendent of the Huntington Works, the company's rolling mill in West Virginia.

In 1957 he was elected assistant vice president of The International Nickel Company, Inc., at which time he was transferred to New York and placed in charge of labor relations at all the company's United States plants. One year later he was appointed general sales manager of the Huntington Alloy Products Division and was elected vice president-sales for that division in May 1960. In December 1961 Mr. Grubb was named vice president of The International Nickel Company, Inc., with responsibility for primary nickel commercial activities in the United States. It was shortly after his election in 1964 as an assistant vice president of the parent company that he was transferred to Europe as managing director of Henry Wiggin, and as a director of International Nickel Limited.

Mr. Grubb attended Wesleyan University, Middletown, Connecticut. He is a member of the Society of Automotive Engineers, American Iron and Steel Institute, American Society for Metals and American Institute of Mining, Metallurgical and Petroleum Engineers.

Mr. Grubb is a member of the New York Yacht Club, Union League Club and India House, all of New York; Baltusrol Golf Club in New Jersey; and St. James' Club, London.

JOHN OLIVER HITCHCOCK, B.Sc.

Vice President
The International Nickel Company of Canada, Limited
The International Nickel Company, Inc.

Director
International Nickel Limited

Mr. Hitchcock was elected vice president-international marketing of The International Nickel Company of Canada, Limited in 1967. At the same time he was elected vice president of The International Nickel Company, Inc.

Mr. Hitchcock was appointed managing director of International Nickel Limited and deputy chairman of Henry Wiggin and Company Limited in 1960, posts he relinquished in November 1967. He was elected assistant vice president of The International Nickel Company of Canada, Limited in 1961. Mr. Hitchcock is also a director of International Nickel Benelux S.A., International Nickel France S.A., International Nickel Iberica Limited, International Nickel Italia S.p.A and International Nickel Services (U.K.) Limited.

His association with International Nickel began in 1927 when he joined the Development and Research Department of the company. He subsequently played an important role in the development of the Nimonic* series of alloys which made possible the development of the jet engine, and in the construction of the new Wiggin works at Hereford built in the early 1950s to produce these alloys.

He served as technical adviser to Non-Ferrous Metals Control of the Ministry of Supply during World War II. In 1943 he acted for the Combined Raw Materials Board in Washington. In 1946 he became personal assistant to the managing director of Henry Wiggin and was appointed assistant managing director of this company four years later. He was elected to the board of directors of International Nickel Limited in 1955 and was appointed sales director. Mr. Hitchcock is also a director of Ametalco Limited.

*Trademark

A graduate of the University of London, Mr. Hitchcock is a Fellow of the Institution of Metallurgists, and member of the Institution of Mining and Metallurgy, Institute of Metals and The Iron and Steel Institute. He is a Fellow of the Royal Aeronautical Society and a member of Council of The Copper Development Association, London.

WILLIAM F. KENNEDY

Secretary
The International Nickel Company of Canada, Limited
The International Nickel Company, Inc.

William F. Kennedy has been secretary of The International Nickel Company of Canada, Limited since May 1952, and secretary of its United States subsidiary since March 1957. He is also a director and member of the executive committee of The International Nickel Company, Inc. and a director of Ajax Petroleum Company, Limited, Compania Centram, S.A., Inter-American Exploration Company, Limited and International Nickel S.A. (Proprietary) Limited.

Mr. Kennedy joined the International Nickel organization in May 1945 as assistant secretary and general solicitor of the parent company and its United States subsidiary. Upon his election as secretary of The International Nickel Company, Inc. in 1957, he relinquished his duties as general solicitor of the two companies. Before joining International Nickel, Mr. Kennedy was associated with Sullivan & Cromwell, the company's general counsel, for 15 years.

After graduating from the University of Pennsylvania in 1926 with a Bachelor of Arts degree, Mr. Kennedy received a Bachelor of Laws degree in 1929 from the University of Pennsylvania Law School. From 1929 to 1930, Mr. Kennedy studied under the Gowen Fellowship at the University of Pennsylvania. He is a member of Phi Beta Kappa Society and the Order of the Coif.

Mr. Kennedy is a member of the American Bar Association, New York State Bar Association and New York City Bar Association. He is also a member of the Mining and Metallurgical Society of America, and the Mining Club, University Club and Lunch Club of New York.

JOHN A. MARSH

Vice President
The International Nickel Company of Canada, Limited

and

Executive Vice President
The International Nickel Company, Inc.

and

President
Huntington Alloy Products Division
The International Nickel Company, Inc.

John A. Marsh has been vice president of The International Nickel Company of Canada, Limited since April 1964 and executive vice president of the company's United States subsidiary, The International Nickel Company, Inc., since December 1966. He has been president of the latter company's Huntington Alloy Products Division since May 1960. He is also a director and member of the executive committee of The International Nickel Company, Inc. and chairman of Nickel Alloy International S. A.

Prior to his present positions, Mr. Marsh had been vice president of The International Nickel Company, Inc. since 1953, and manager of the company's Huntington Alloy Products Division since 1958. From 1936 until his appointment as assistant vice president of the United States subsidiary in 1952, Mr. Marsh held positions of increasing responsibility at the company's Huntington, West Virginia, and former Bayonne, New Jersey, plants. He joined the International Nickel organization in 1928 as a laboratory assistant at the Huntington Works.

Mr. Marsh received a Bachelor of Science degree from the University of Michigan in 1928. He is a member of the American Society of Mining, Metallurgical and Petroleum Engineers and American Iron and Steel Institute. Mr. Marsh is also a member of the City Midday Club and Broad Street Club, both of New York City; the Echo Lake Country Club and Baltusrol Golf Club in New Jersey; and Royal Poinciana Golf Club in Florida.

WALTER A. McCADDEN

Comptroller
The International Nickel Company of Canada, Limited
The International Nickel Company, Inc.

Walter A. McCadden has been comptroller of The International Nickel Company of Canada, Limited and its United States subsidiary, The International Nickel Company, Inc., since May 1955. He is also comptroller of a number of International Nickel subsidiaries, and has been a director and member of the executive committee of The International Nickel Company, Inc. since December 1961.

Prior to his present positions, Mr. McCadden had been assistant comptroller of both companies since 1949. He joined The International Nickel Company, Inc. in 1935 as a tax accountant following several years as senior accountant at Price Waterhouse & Co.

Mr. McCadden attended New York University and received a degree in Accounting and Business Administration from Pace College in 1929. He was awarded an honorary degree of Doctor of Commercial Science by Pace College in June 1967.

A certified public accountant in New York State, Mr. McCadden is a member of the American Institute of Certified Public Accountants and the New York State Society of Certified Public Accountants. He is a trustee of Pace College and of Malcolm Gordon School, Limited, Garrison, New York. He is also a member of the City Midday Club and the Downtown Athletic Club, both of New York.

FELIX M. A. NOBLET

Treasurer
The International Nickel Company of Canada, Limited
The International Nickel Company, Inc.

Felix M. A. Noblet has been treasurer of The International Nickel Company of Canada, Limited and its United States subsidiary, The International Nickel Company, Inc., since April 1954. He is a director and a member of the executive committee of The International Nickel Company, Inc., and treasurer of a number of International Nickel subsidiaries. Mr. Noblet joined International Nickel in September 1942 as assistant treasurer, and the same year was elected assistant secretary of the parent company, as well as assistant treasurer and assistant secretary of the United States subsidiary.

Mr. Noblet, a Canadian, received his early business training in Canadian banking. Before joining International Nickel, he had been associated with the Bank of Montreal in various capacities for 15 years, and from 1936 to 1942 he was assistant to the general manager. From 1925 to 1928, Mr. Noblet was employed by Canadian Pacific Steamships, Limited.

A director and past president of the Canadian Society of New York, he is also a member of India House and the Canadian Club of New York; the Canadian Club, Royal Canadian Yacht Club and the York Club of Toronto; and the Rideau Club of Ottawa.

JOHN H. PAGE

Assistant to the Chairman
The International Nickel Company of Canada, Limited

and

Vice President
The International Nickel Company, Inc.

John H. Page has been assistant to the chairman of The International Nickel Company of Canada, Limited since January 1969, and vice president of its United States subsidiary, The International Nickel Company, Inc., since December 1966. Mr. Page joined International Nickel in September 1965 as special assistant to the chairman.

For four years prior to joining International Nickel, Mr. Page was executive vice president of the Free Europe Committee, Inc. From 1946 to 1961 he held various management and public relations positions in the Bell Telephone organization, resigning in 1961 as vice president of the Pacific Northwest Bell Telephone Company.

Mr. Page received a Bachelor of Science degree from Harvard University in 1942. He is a director of the International Development Foundation; a member of the Council on Foreign Relations; a vice president of The American Research Hospital in Poland, Inc.; a director of the Huntington Hospital in Huntington, Long Island; and a member of the Visiting Committee for the Press of Case Western Reserve University.

PAUL QUENEAU

Assistant to the Chairman and Consulting Engineer
The International Nickel Company of Canada, Limited

and

Vice President
The International Nickel Company, Inc.

Paul Queneau has been assistant to the chairman and consulting engineer of The International Nickel Company of Canada, Limited since January 1967. He has also been vice president of the United States subsidiary, The International Nickel Company, Inc., since 1958.

Prior to his present positions, Mr. Queneau had been technical assistant to the president of the parent company since 1960 and assistant vice president of The International Nickel Company, Inc. since 1954. Mr. Queneau joined the International Nickel organization in 1934 as a metallurgical engineer at the Huntington, West Virginia, plant. He subsequently held positions of increasing responsibility in the parent company's Research Department at Copper Cliff, Ontario, heading it in 1941. He was transferred to New York in 1948 as metallurgical engineer, Executive Department.

Mr. Queneau is a graduate of Columbia University, where he received Bachelor of Arts, Bachelor of Science and Engineer of Mines degrees. He continued advanced studies as an Evans Fellow at Cambridge University, England.

He holds numerous patents in the metallurgical field and is the author and editor of many published technical books and papers. He is the technical editor of the book, "The Winning of Nickel," the most comprehensive review of the geology, mining and extractive metallurgy of nickel in the past half century. He is also the editor of "Extractive Metallurgy of Copper, Nickel and Cobalt" and the co-editor of "Pyrometallurgical Processes in Nonferrous Metallurgy."

He was awarded Columbia's Engleston Medal "for distinguished engineering achievement" in 1965 and was elected a Fellow of The Metallurgical Society, American Institute of Mining, Metallurgical and Petroleum Engineers in 1967 "in recognition of his stimulating leadership in the successful development of valuable innovations in the metallurgy of nickel, copper, and associated metals." He was awarded A.I.M.E.'s 1968 James Douglas Gold Medal "for distinguished achievement in nonferrous metallurgy." He serves on Columbia's Engineering Council and M.I.T's Visiting Committee.

Mr. Queneau is president of The Metallurgical Society and a director of the American Institute of Mining, Metallurgical and Petroleum Engineers, a director of the Engineering Foundation and a member of the National Society of Professional Engineers, Canadian Institute of Mining and Metallurgy, Engineering Institute of Canada, Australasian Institute of Mining and Metallurgy and British Institution of Mining and Metallurgy.

Mr. Queneau has been a member of several scientific expeditions to the Arctic and has served as chairman of the U.S. Navy Arctic Research Advisory Committee. After Pearl Harbor he entered active duty from the U.S. Army Reserve as a second lieutenant of engineers and advanced through grades to colonel. He served overseas in five campaigns starting with the Normandy beachhead, was chief-of-staff of the Army Ruhr Mines Task Force, later serving in the Arctic.

He is a member of the University Club, Explorers Club and Mining Club, all of New York City, the Army and Navy Club of Washington, D.C. and the Country Club of Fairfield in Connecticut.

ASHBY McC. SUTHERLAND

Assistant to the Chairman - Law
The International Nickel Company of Canada, Limited

and

Vice President and Chief Legal Officer
The International Nickel Company, Inc.

Ashby McC. Sutherland has been assistant to the chairman - law of The International Nickel Company of Canada, Limited and vice president and chief legal officer of its United States subsidiary, The International Nickel Company, Inc., since 1966. Prior to his present appointments, he had been general solicitor of both companies since 1957. He has also been assistant secretary of the Canadian parent company since 1956, and of the United States subsidiary since 1955. Mr. Sutherland joined the International Nickel organization in 1953.

Mr. Sutherland received a Bachelor of Arts degree in economics in 1942 from The University of the South, Sewanee, Tennessee, an Industrial Administrator degree from Harvard Graduate School of Business Administration in 1943, and a Bachelor of Laws degree from Harvard Law School in 1949. He is a trustee of The University of the South. He is a member of the American Society of International Law, American Bar Association, New York State Bar Association and Association of the Bar of the City of New York.

He is also a member of the Harvard Club, Knickerbocker Club and Lunch Club, all of New York City; the International Club of Washington, D.C.; and the Waccabuc Country Club, Waccabuc, N. Y.

H. FRANKLIN ZURBRIGG

Vice President, Exploration
The International Nickel Company of Canada, Limited

H. Franklin Zurbrigg has been vice president, exploration of The International Nickel Company of Canada, Limited since August 1968.

Prior to his present position, Mr. Zurbrigg had been vice president and director of exploration of The International Nickel Company of Canada, Limited since 1967. He had been assistant vice president and chief geologist since 1964. He joined the International Nickel organization in 1933 as a geologist at the company's mines at Copper Cliff, Ontario. He subsequently held positions of increasing responsibility, and in 1956 was named chief mines geologist of the Ontario Division.

Mr. Zurbrigg is president of Canadian Nickel Company Limited, and an officer of other subsidiaries which conduct International Nickel's worldwide exploration activities.

A graduate of Queen's University, Kingston, Ontario, Mr. Zurbrigg received a Bachelor of Science degree in 1931 and a Master of Science degree in 1933.

Mr. Zurbrigg is a fellow of the Geological Society of America and the Geological Association of Canada. He is a member of the Canadian Institute of Mining and Metallurgy; American Institute of Mining, Metallurgical and Petroleum Engineers; Mining and Metallurgical Society of America; and Society of Economic Geologists. He is also a member of the Association of Professional Engineers of Manitoba.

DEAN D. RAMSTAD

Assistant to the President
Assistant Secretary
The International Nickel Company of Canada, Limited

and

Vice President
Assistant Secretary
The International Nickel Company, Inc.

Dean D. Ramstad has been assistant to the president of The International Nickel Company of Canada, Limited, and vice president of its United States subsidiary, The International Nickel Company, Inc., since December 1966. He is also assistant secretary of both companies, and has been active in connection with International Nickel's exploration activities.

Mr. Ramstad was elected assistant vice president of both the parent company and its United States subsidiary in 1963. He joined The International Nickel Company, Inc. in 1957 as assistant secretary and as a member of the general solicitor's staff. Before joining International Nickel, he was an attorney with the firm of Sullivan & Cromwell in New York.

Mr. Ramstad graduated from the University of Minnesota, receiving a Bachelor of Arts degree in economics in 1944 and a Bachelor of Laws degree in 1949. He was awarded the Order of the Coif at the university in 1950. He is a member of the American Bar Association.

LOUIS S. RENZONI

Vice President - Process Research
The International Nickel Company of Canada, Limited

Louis S. Renzoni has been vice president - process research of The International Nickel Company of Canada, Limited since July 1968. Prior to his present appointment he had been vice president of the company since January 1967 and manager of process research - Canada since 1960.

Mr. Renzoni had been assistant vice president of the company since 1964. In 1960 he was transferred from Copper Cliff, where he had been superintendent of research since 1956, to the company's offices in Toronto. He joined International Nickel in 1937 as a research chemist at Port Colborne, Ontario.

He received a Bachelor of Science degree in 1935 and a Master of Science degree in 1936 from Queen's University, Kingston, Ontario. In May 1969 he received the honorary degree of Doctor of Science from Queen's University.

Mr. Renzoni is a member of the American Institute of Mining, Metallurgical and Petroleum Engineers and the American Chemical Society, as well as the Canadian Institute of Mining and Metallurgy. He is also a Fellow of the American Association for the Advancement of Science and the Association of Professional Engineers of Ontario.

The author of many papers and articles on metallurgy, he has been granted patents on extractive processes in nickel metallurgy. In 1960 and again in 1963, Mr. Renzoni received the Gold Medal Award of the Extractive Metallurgy Division of the American Institute of Mining, Metallurgical and Petroleum Engineers. In 1964 Mr. Renzoni was recipient of the Airey Award presented by The Metallurgy Division of the Canadian Institute of Mining and Metallurgy for outstanding contribution to metallurgy in Canada. In 1968 he received the R. S. Jane Memorial Lecture Award of The Chemical Institute of Canada for exceptional achievement in chemical engineering.

He is a member of the Copper Cliff Club.

WILLIAM STEVEN

Vice President - Process Technology and Product Development
The International Nickel Company of Canada, Limited

and

Vice President
The International Nickel Company, Inc.

William Steven has been vice president - process technology and product development of The International Nickel Company of Canada, Limited since July 1968, and vice president of its United States subsidiary, The International Nickel Company, Inc., since 1966.

Dr. Steven joined The International Nickel Company, Inc. in 1959 as director of research and assistant vice president, after an association of 13 years with the parent company's United Kingdom subsidiary. He was named assistant vice president of the parent company in 1965.

He attended the Royal College of Science and Technology, Glasgow, Scotland, where he received a Bachelor of Science degree in 1939 and a Doctor of Philosophy degree in 1942. He was awarded the Blyth Memorial Prize in Natural Philosophy in 1936 and the Walter Duncan Research Scholarship in 1939.

The author of many technical papers on steels and cast iron, Dr. Steven is a Fellow of the Institution of Metallurgists in the United Kingdom. He is a member of the American Society for Metals; Institute of Metals; Iron and Steel Institute; American Institute of Mining, Metallurgical and Petroleum Engineers; and the Canadian Institute of Mining and Metallurgy.

He is also a member of the Engineers' Club and City Midday Club in New York and the Engineers' Club in Toronto.

GLENN H. CURTIS

Vice President and Chief Engineer
The International Nickel Company of Canada, Limited

Glenn H. Curtis joined The International Nickel Company of Canada, Limited in August 1968 as vice president and chief engineer.

Mr. Curtis had been president and chief officer of Stone and Webster Canada, Limited since 1962. He joined Stone and Webster in 1955. From 1950 to 1955 he held various positions in job engineering, contract and construction management with a Montreal construction firm.

He received a Bachelor of Applied Science degree in civil engineering from the University of Toronto in 1948 and an M.B.A. degree from Harvard University Graduate School of Business Administration in 1950.

Mr. Curtis is a member of the Engineers' Club, University Club and The Toronto Club, all of Toronto; and the Montreal Badminton and Squash Club.

CORPORATE HISTORY

The history of The International Nickel Company of Canada, Limited can be traced back to the discovery of nickel-bearing ores in the village of Orford, Quebec, more than 90 years ago.

In 1877, the Orford Nickel Company was formed to mine these ores. In 1881, that company -- then known as the Orford Nickel and Copper Company -- purchased land for a smelter at Constable Hook in Bayonne, New Jersey. Not long after, in 1883, engineers of the Canadian Pacific Railway, clearing the way for tracks, uncovered a deposit of nickel- and copper-rich ore in the vicinity of Sudbury, Ontario, and this led to the formation of the Canadian Copper Company in 1886. During the years that followed, the two companies reached an agreement under which Orford refined the Canadian Copper Company's ores.

In 1900, The Mond Nickel Company, Limited was formed to develop Sudbury ores for treatment in Great Britain. Several years earlier its founder, Dr. Ludwig Mond, had discovered and developed, in conjunction with chemist Carl Langer, the Mond carbonyl process for refining nickel.

By 1902, it was apparent to the Orford Copper Company (formerly Orford Nickel and Copper Company) and the Canadian Copper Company that one could not survive without the other. Furthermore, extensive expansion was necessary in both. As a result, the two companies and several smaller ones merged that year to form the International Nickel Company (incorporated in New Jersey).

In order to consolidate the new company's mining interests in Canada, The International Nickel Company of Canada, Limited was formed in 1916 as a subsidiary of the New Jersey company and, in 1928, became the parent company.

During the 1920's, The International Nickel Company of Canada, Limited and The Mond Nickel Company, Limited started mining operations on adjacent properties in the Sudbury Basin. These operations proved to lead to the same ore body, the Frood, one of the largest ever discovered. In order to effect a single long-term mining plan for the economic and sound development of the Frood mine, the two companies merged as of January 1, 1929.

Thereafter, the two major subsidiaries of The International Nickel Company of Canada, Limited were The International Nickel Company, Inc. in the United States and International Nickel Limited (formerly The Mond Nickel Company) in the United Kingdom.

INTERNATIONAL NICKEL

The International Nickel Company of Canada, Limited
Toronto, Ontario

The International Nickel Company, Inc.,
New York, N.Y.

International Nickel Limited,
London, England

1969/1

INTERNATIONAL NICKEL
MAGAZINE

Mr Watkins

a New Industry for Guatemala

Upon the conclusion of necessary arrangements with the Guatemalan Government, International Nickel's majority-owned subsidiary, Exploraciones y Explotaciones Mineras Izabal, S.A. (Exmibal), will begin large-scale construction of nickel mining and processing facilities near Lake Izabal in northeastern Guatemala. The construction, which will take fully three years, will employ as many as 2,000 Guatemalans during peak periods, and bring total investment in the project to an estimated $180,000,000.

The Exmibal project will be one of the first major mining operations in Central America. It involves the establishment of facilities for the annual production, from lateritic ores, of at least 50,000,000 pounds of nickel in nickel-containing products. The processing plant will operate on the basis of a pyrometallurgical process developed specifically for the Guatemalan lateritic ores by International Nickel research.

During the period of negotiations, Exmibal has engaged in an extensive development program, including the outlining of ore bodies on both sides of Lake Izabal, and ore and soil testing, preliminary to construction. The site of the Exmibal plant, viewed here from the mining site, lies on the northwest side of Lake Izabal. The area has been cleared for the plant and for a barge canal to the lake; temporary facilities for housing construction workers are shown at the left.

Photograph by Joya Hairs, Guatemala City

INTERNATIONAL NICKEL

MAGAZINE

1969/1

The Cover

Motion—especially high-speed motion—has always had a fascination for man. In mankind's early days, and for many centuries thereafter, it was a fast horse that drew all eyes. With the beginnings of mechanized transport came the railroad. Increasingly eclipsed in the 20th century by the automobile and the airplane, trains, like this TEE racing through France, are now beginning to make a comeback (see page 2). And in trains, and planes, and ships, and cars—nickel has a great future in the transportation industry (see page 7).

Photograph courtesy of German Federal Railways.

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THE GREAT TRAIN RACE

Railroads Call on New Technologies to Beat the Clock and the Competition

by GEORGE BARLOW

Transportation progress really started when some anonymous genius devised the wheel. But in the chapter that began when Stephenson's "Rocket" first puffed across the English countryside less than 150 years ago, the pace has grown faster and faster. Now the railroads are ready for their most exciting developments since steam and steel were put in motion.

From the traveler's point of view, trains have chugged along with steady but not very rapid improvements from the first clumsy wagons-on-wheels to graceful stainless steel streamliners. But that progress hasn't had the drama that has marked some other areas of transportation—aviation's leap from sputtering power box-kites to supersonic transports, for example. As a result, some of the railroads' most outstanding achievements haven't had the acclaim and recognition they have rightfully earned.

Nearly 15 years ago, a French train set an impressive speed record of over 200 miles an hour. Yet at the time, all the fanfare surrounding the new jet airliners overwhelmed the importance to the travel world of the railroad record. The computer applied to air transportation stole the glamour of the computer that made basic improvements in railroad transportation. The automobile industry, with its annual high-powered fashion promotions trumpeting each year's style changes, took the spotlight from the railroads' quiet but continuous development of more luxurious, more comfortable—and more efficient—passenger equipment. And almost unnoticed, the railroads increased their speed averages year by year until on many regularly scheduled runs they reached the 75-125 mile-per-hour range.

Then Something Happened

As the glamourous airlines and the convenient highways attracted more and more travelers, their glamour dimmed and their convenience dwindled. One- to two-hour holding patterns over major airports have become commonplace. Bumper-to-bumper traffic crawling along "high-speed highways" is a daily occurrence, and the trip from centre-city to airport often takes longer than the flight itself. In this context, a train that takes a traveler from the heart of one city to the heart of another in complete comfort at 100-mile-per-hour speeds has suddenly become highly competitive in both glamour and convenience. Today's high-speed trains are already at that stage of development, and they are moving ahead fast.

But the present development has not been achieved simply by better technology. Railroads don't operate in a political vacuum. Most of the world's rail systems, because of their vital role in the economy, are controlled completely or in some degree by national governments. Their growth and operations are subject to both domestic and international pressures.

In spite of this, the area where one might expect the most competitive spirit internationally is one of the best examples of coordinated development of a modern high-speed railway system: Western Europe.

Competition For The Airlines

From the first train on the continent – for which France claims the honour with a steam passenger train converted from a horse-drawn freight train in 1832—European railroads have developed individual techniques and equipment. But since 1945, with the reconstruction of all the rail systems in Western Europe after their wartime damage, planning has had a much more international approach. And while each country maintains its own national system, the outstanding train in each is the TEE (Trans-Europ-Express). These are the trains that are giving the airlines and the highways the toughest competition in the "middle distances" that make up so large a part of Western European travel.

The TEE was planned primarily to attract the growing international business travel of postwar Europe. It whistles across borders without a pause (customs formalities are taken care of aboard the train). Its electrified locomotives give it speeds of up to 125 miles per hour and its schedules are planned around the business day. For example, on the TEE *Ile-de-France,* a traveler can leave Paris in the morning, have lunch in Amsterdam, leave there at dinnertime, and be back in Paris the same night. On the TEE *Mont-Cenis,* he can leave Milan in the morning, have a full afternoon in Lyon, and be back in Milan in the late evening. Or he can take the *Oiseau Bleu* from Brussels at 7:30 in the morning, arrive in Paris at 10, have the full day there till after 8:30 in the evening, and still be back in Brussels the same night.

TEE trains are all first class and their air-conditioned cars are beautifully designed for comfort and convenience. Many of them have a nickel stainless steel skin which eliminates much exterior maintenance. Nickel stainless is also widely used in galley and bar cars.

Trains At 300 Miles Per Hour?

The 24 TEE trains are the best operating demonstration in the world of a large coordinated system of high-speed rail transport. But while these trains maintain regular schedules with average speeds in the near 100-mile-an-hour range, they don't represent what railroad men mean when they talk about high-speed trains today. They are talking about trains that will go from 200 to 300 miles an hour—and they are talking about doing it within the framework of existing rail systems.

Operating between Paris, Brussels, and Amsterdam are four TEE trains, "Etoile du Nord," "Ile-de-France," "Oiseau Bleu," and "Brabant." The car bodies are all nickel stainless steel, both structure and sheathing; stainless steel is also used extensively on the sides of the locomotive. Similar but even more elaborate trains are being built in nickel stainless for the new "Mistral," on the Paris-Nice run.

There are many answers to be found before regularly scheduled trains can operate at speeds anywhere near that level. Braking presents a major problem; signal systems another; fixed installations like stations and turnaround points capable of operating within the framework of such accelerated schedules, another. The radius of curves and the tremendous pressures tracks are subjected to by the added centrifugal force at such speeds; vibration and the aerodynamic effects of passing trains, tunnel entrances, and large fixed objects —all are problems that must be solved.

Putting Ideas To Work

But a surprising number of these problems are well on the way to solution by the development work being done in various countries. In Germany, for instance, an automatic microwave control system is in operation on the "E 03," the fastest of the German locomotives. The system uses electronic pulses from control towers as far as six miles away to regulate the train's speed and keep it constant on level ground and inclines. This may be a prototype for future automated operations.

In France, a different system is in trial use to accomplish the same purpose. Called "optimisation of power," it uses a constantly self-correcting computer to regulate the application of throttle or brakes, producing a smoother acceleration and deceleration with less waste of power than is possible manually. Important work is being done in France, too, on establishment of a "three-cantonment" signal system to alert the engineer that he will have to begin braking at the entry to the next approaching signal block. This gives him the additional time and distance he needs to stop at higher speeds.

In the area of system unification and improved facilities for faster schedules, Belgium has completed a significant junction of separate stations in Brussels to permit through passenger service without the need for changing stations. A particularly important part of this project is the linking of the Brussels International Airport to the Brussels Central Station with a 16-minute train service (making the same trip that may take up to one hour by car or bus). This service takes the traveler directly from his plane to his train connection for anywhere in Western Europe. In England, British Railroads have a similar plan under study. So important has this link become that it may be a deciding factor in the location of the new London Airport. Italy will apply a number of the newest ideas in trains and roadway construction to a new line between Rome and Florence. With planned speeds of up to 150 mph, running time is scheduled for 90 minutes compared to the present three hours.

Resuming The Fast-Passenger-Train Race

In the United States and Canada, progress toward higher passenger train speeds —with all the expense and equipment this involves—has been sidetracked by intense competition from automobiles and airlines, while the railroads turned their ingenuity to a more dependable source of income, freight transport. Interest centred on development of unit trains, highly specialized car designs, trains that integrate with production-line timing to bring parts from plant to assembly line on precise schedules, and greater efficiency in car cataloguing and location by computer and TV-spotting systems.

But back in 1893 a locomotive of the Empire State Express broke the 100-mile-an-hour mark and many North American railroaders are eager to resume the fast-passenger-train race. In the United States, the Department of Transportation has taken a lively interest in the whole subject. This government agency is concerned with the growing problems of mass transportation in the densely populated urban-suburban corridors which are emerging in every section of the country. One of the largest of these (and one that incorporates all the most difficult problems) is the Boston-New York-Washington complex. Largest railroad in the midst of the exploding population centres of this belt is the newly-merged Penn-Central. In a joint venture, the railroad and the government are testing a high-speed train that is expected to bring 120-mile-an-hour speeds to this line. The first of these all stainless steel "Metroliners" are in regular service on a schedule that cuts more than one-half hour from the previous express time from New York to Washington.

Canada also has a new series of high-speed trains going into immediate service. Five trains have already been delivered to

Against the background of a Brussels skyscraper is the "Saphir" of the German Federal Railways.

the Canadian National Railway for operational testing, and regular service is scheduled between Toronto and Montreal. Each of the 14-car trains is powered by eight 400-horsepower gas turbine engines and is capable of operational speeds of up to 130 miles per hour.

The metals used in these and other gas turbine engines are critical to their operation. Because of the extreme temperatures and stresses, the strength and heat resistance of nickel alloys make them ideal for many turbine engine components. Shafts, blades, casings, discs, and other parts are made with metal alloys containing from 2 per cent to as much as 78 per cent nickel.

The Canadian turbo trains utilize another idea that has been widely studied as a partial solution to greater speed on existing tracks and curves—pendular suspension. This technique provides a lower centre of gravity and, by the pendulum action of the cars as the train rounds a curve, converts some of the lateral centrifugal force into a downward force so passengers experience less of a feeling of vertigo—or giddiness.

There is, of course, much interest in Japan's Tokyo-to-Osaka line, where, for several years, 120-mile-an-hour schedules have been routine. But railroad men in other countries point out that the nature of the landscape profile is ideal and that the entire line was constructed with this speed as its standard. The problem is more complex where existing grades and curves must be rebuilt—or compensated for in other ways.

One of the Swiss-built, 6-car electric trains operating as the "Cisalpin" between Paris and Milan, or the "Gottardo" and "Ticino" between Basle and Milan.

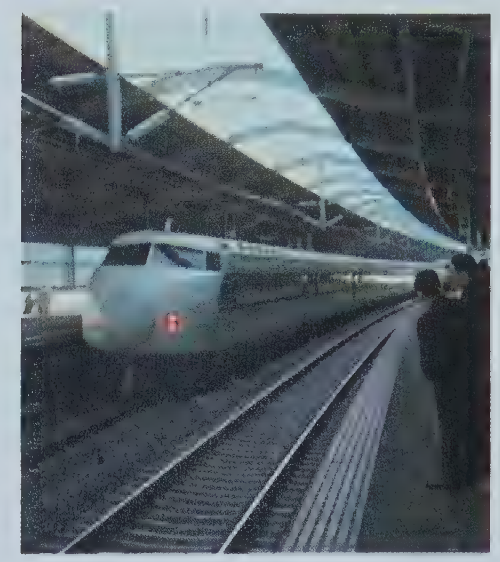
A Glimpse Of The Future

But it is the application of new technologies to rail travel that makes the most exciting promise for the near future. Trains that ride on a cushion of air are one possibility. In England, where a hovercraft car ferry service is already in operation, experimental work is well advanced on a "tracked hovercraft" that rides on top of a single large rail. The National Research Development Council has arranged for twenty miles of test track to be built near Hythe. An experimental vehicle with a linear induction motor for traction and Cockerell jets to provide the air cushion is in final design stage.

Simultaneously, in France, the inverted version of the same type of vehicle has actually been constructed and is being tested in the form of a suspended cabin seating twelve passengers below the rail and air-cushion bearing. Like the English hovercraft, the French "Urba" also uses a linear induction motor for traction as well as for electromagnetic braking.

Its nickel stainless steel clad exterior glittering in the sun, Penn-Central's first Metroliner idles briefly at a station between high-speed New York-Washington runs.

Japan's Tokyo-Osaka express operates regularly at 120 mph speeds.



Closer to actual operation is a French rail-car which combines a diesel engine and a gas turbine. The diesel takes over primary acceleration until the car reaches a speed of about 25 miles an hour. At this point the gas turbine begins to come into action and as the car increases speed beyond 50 miles an hour, the diesel begins to withdraw its power. The faster the car goes, the more power it draws from the turbine and the less it draws from the diesel. In 1967, an experimental car of this kind reached a speed of nearly 150 miles an hour. Ten of these trains have been ordered by the French National Railroad to go into service on the Paris-Caen line in 1969 or 1970.

An Integration Of Systems

All the efforts on the part of the railroads of the world are still being advanced in a competitive context—as a struggle for existence against the competition of air and highway transport. None is likely to win total victory. The long range result will be controlled by economics of efficiency. Mass transportation demands a dramatic new solution, but this is more likely to result from an integration of systems than a complete new approach to any one form of transport.

No nation or group of nations can afford to make obsolete its whole rail system and replace it with a new type. Nor can any country or group afford to create sufficient new airport or highway facilities quickly enough to provide a total solution with those systems.

More likely is the possibility that each system will do the portion of the job it can perform most economically, and that it will merge itself into the other systems as it approaches the areas where they deliver optimum performance. In terms of existing equipment, hovercraft car-ferries, piggyback truck-trains, container ships, and centre-city-to-airport fast train-to-plane systems may be only primitive examples of how this integration of systems will be accomplished.

PICTURE CREDITS
Page 2: TEE Commission
Page 4: French National Railways (SNCF)
Pages 5, 6: TEE Commission; W. Studer
Page 7 (left): Eddie Lau, Inco, Inc.
(right): Pete Gridley

George Barlow is a freelance writer and consultant whose interest in railroads began when he was an engineering student at California's Stanford University (the founder, Senator Leland Stanford, was one of the "Big Four" who built the first railroad linking America's east and west coasts). Mr. Barlow now lives in New York, has traveled widely in Europe, America, and the Pacific, and admits to being fascinated "with all forms of transport except walking." In preparing this article, he spent two months in Germany, Austria, Yugoslavia, Italy, France, England, Belgium, and Holland, talking to railroad people, systems designers, metallurgists, government agencies, engineers, suppliers—and passengers, both on and off the trains.

The Place: A New York restaurant.
The Time: A crisp December evening in 1968.
The Audience: Some sixty representatives of U.S. and foreign newspapers, trade publications, and wire services.
The Occasion: A Christmas get-together with the press.
The Focus of Attention: Albert P. Gagnebin.

Elected President of The International Nickel Company of Canada, Limited in 1967, Albert P. Gagnebin has had an outstanding career in metallurgy. He achieved international renown for the discovery in 1946 of ductile iron, in collaboration with another Inco metallurgist, Keith D. Millis. In 1967, he became one of the eight recipients since its inception in 1932 of the Grande Medaille d'Honneur de L'Association Technique de Fonderie.

After completion of his studies at Yale University (B.S., 1930; M.S. in metallurgy, 1932), Mr. Gagnebin joined International Nickel's product research laboratory in the United States, engaging in ferrous metals research. Following the invention of ductile iron, he transferred to the company's New York office to establish a group for the product's commercial development. In 1955, he became Assistant Manager of the Nickel Sales Department, becoming Manager in 1956, and thereafter his rise—to Vice President, to Executive Vice President, to President—was rapid.

Mr. Gagnebin is vice president and a director of the Tokyo Nickel Company Limited, Tokyo, Japan; a trustee of the Atlantic Mutual Insurance Company and the Bank of New York; and a director of the Abex Corporation, The Toronto Dominion Bank, The International Copper Research Association, Inc., and the American Society For Friendship With Switzerland. He is a councillor of the French Chamber of Commerce in the United States, Inc.; a member of the Board of Governors of the Canadian Export Association; and a member of the Pan American Society of the U.S.

NICKEL TODAY AND TOMORROW

by ALBERT P. GAGNEBIN

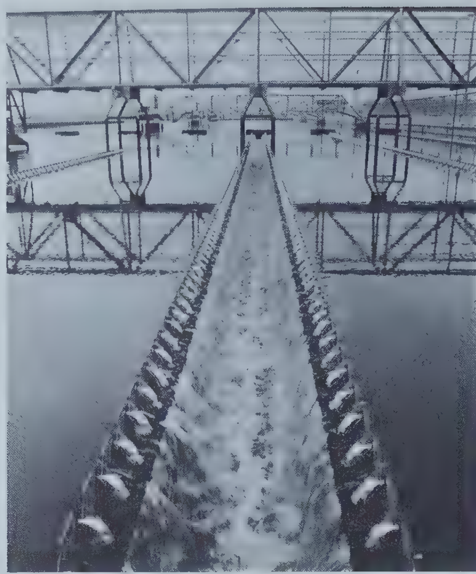
Today the imbalance between nickel supply and demand continues. The lack of supply has held free-world consumption of primary nickel to approximately the same level as last year—just over 800,000,000 pounds. Next year, as production rises, consumption can be expected to rise accordingly. But, barring major changes in the level of free world economy, I believe nickel will remain in short supply throughout 1969.

The long-term market for nickel is strong. The future demand comes from a wide spectrum of the economy and is, by and large, in industries which can be expected to grow more rapidly than the general economy. In the near future, the

Three major industries with a growing demand for nickel:

Natural Gas

Water Pollution Control



Shipping

availability of nickel, rather than markets, will be the limiting factor on its consumption. When supplies become plentiful, the long-term growth trend averaging about 6 to 7 per cent per year, which we have seen in this decade, can be expected to continue. While we naturally have slowed our short-term promotional efforts, we have and will continue to put very considerable money and talent toward research and product development aimed at longer-range markets.

The current imbalance between supply and demand is, of course, not in any way to our liking. We want always to be in a position of being able to deliver whatever our customers want–and, in fact, to be in a position to back them up in developing the markets for their products.

Keeping The Imbalance In Perspective

While expansion of the market has been hindered by lack of availability, existing nickel-containing products have, with few exceptions, been in free supply. Moreover, we have not noticed serious or substantial substitutions of other materials for nickel-containing materials. In total, while the current shortage is not in our or our customers' interest, it has not affected, nor do I believe it will affect, the long-term, rapid growth of nickel consumption.

You are all aware of our plans and actions for expanding our nickel production capacity in Canada and, over the longer term, outside of Canada. As is perhaps inevitable when one tries to crowd a very large expansion program on top of peak production, the increase in production we had hoped for is behind the optimum schedule we had set for ourselves. This is certainly not for lack of effort or willingness to invest, but results rather from the physical limitations of being unable to do everything we would like as rapidly as we had hoped. The single biggest limitation has been the shortage of labour in Canada, both to ourselves and to the contractors building our expanded facilities.

The Basis Of Future Expansion

Below are listed some of the industries and applications which we see as forming the basis of expanding nickel markets in the future. In these applications, nickel's inherent ability to provide corrosion resistance, high strength, ductility, heat resistance, and embrittling resistance at low temperatures, compels its use in the alloys involved. These uses are, of course, in addition to traditional applications such as in plating and coinage.

Aerospace

The DC-3, introduced in the early 1930s, contained about 350 pounds of nickel, mostly in landing gears, propellers, and gearing. Introduction of the jets in the late 1950s ushered in a new era of air transport which has seen the nickel content increase from 3,500 pounds in the Boeing 707 to about 11,000 pounds in the Boeing 747 which will begin operation in about a year. The Boeing 2707, better known as the SST, scheduled for introduction in the late 1970s, will contain about 18,000 pounds of nickel, or more than 50 times as much as the DC-3.

Vehicular Turbines

Major producers of truck and off-highway equipment engines are developing gas turbines which will be marketed in the early 1970s. These units will be much quieter, minimize air pollution, reduce driver fatigue, and provide more power for hill-climbing and heavy loads. Nickel

"The trend in the petroleum and petrochemical industries is toward very large processing units."

"The Boeing 2707, better known as the SST, scheduled for introduction in the late 1970s, will contain about 18,000 pounds of nickel, or more than 50 times as much as the DC-3." (Photo credit: American Airlines)

"Copper-nickel tubing has made million-gallon-per-day desalination a practical operating reality."

alloys will be used liberally throughout for such components as turbine wheels, combustion components, and gears.

Nuclear Power

The unexpected surge in nuclear plant orders of the past two years represented 40 per cent of the total new orders for power plants in the United States. The Atomic Energy Commission now predicts that by 1980 nuclear plants might have a generating capacity of more than 150,000 megawatts, about 25 per cent of the total generating capacity. High-nickel alloys are essential in these nuclear power projects.

Water Pollution Control

Federal restrictions on water pollution will require the expenditure of about $2.9 billion through 1975 for new waste water treating facilities. The requirement for maintenance-free service points to increased use of nickel alloy steels, including stainless steel, in this market. It is expected that by 1975 the consumption of nickel stainless steel alone in this area will increase fourfold over the present rate. In addition, there is growing interest in incinerating sewage sludge which presents new opportunities for nickel in equipment employing new design concepts. Prototype units now under study are constructed almost entirely of nickel stainless steels and other nickel-containing alloys.

Liquefied Natural Gas

Increasing demand for natural gas as a domestic and industrial fuel has caused utility companies to provide large storage facilities for peak shaving and base load operations. Since many times larger volumes of gas can be stored in the liquid state at –258 F, 9 per cent nickel steel is generally specified on an economic basis for the tanks to provide adequate toughness at the cryogenic temperature. We expect this market to continue to grow.

Petroleum And Petrochemical

The trend in the petroleum and petrochemical industries is toward very large, single-stream processing units, which must operate at high temperatures and pressures for optimum efficiency. The material requirements for such equipment are expected to increase annual nickel consumption very materially.

Marine Applications

Commercial and naval markets for copper-nickel have been growing at exciting rates over the past few years, and we expect these growth rates to continue. In shipbuilding, nickel-containing copper alloys have enabled commercial as well as naval vessel owners to substantially reduce their full life cycle costs.

Nickel alloys are also expected to play a major role in several important new developments in marine transportation—gas turbine propulsion for high-speed cargo ships and Hovercraft hydrojet propulsion units, and nuclear-powered merchant vessels.

Desalination is another rapidly growing market where copper-nickel tubing has made today's million-gallon-per-day desalination a practical operating reality in water-short areas around the world. There is intense competition from titanium, aluminum, and non-nickel-containing copper alloys, but we expect copper-nickel to continue as the basic material against which all others are evaluated.

GUATEMALA'S NEW MINT

by J. ALFRED BARRETT

Last September, in a simple ceremony attended by some two hundred guests, Guatemala's new Mint was formally inaugurated by President Julio César Méndez Montenegro. The act marked a distinct break with the past, for the modern building that rises on an acre of ground in the southern outskirts of Guatemala City is a far cry from the old-fashioned structure in the centre of the city that had housed the Mint since 1779.

For more than two hundred years after the Conquest in 1524, colonial Guatemala was not allowed by the Spanish Crown to coin its own money. Until 1733 most of the currency circulating in the colony was either brought directly from Spain or minted in Mexico, although growing trade with South America, especially with the Viceroyalty of Peru, made coins from Peru and Chile fairly common.

Authorization to establish a Royal Mint in Guatemala was granted by Philip V of Spain in a decree dated January 17, 1731. With the faulty communications of the time, however, the document did not reach its destination until almost a year later—on January 7, 1732.

Negotiations were immediately begun to bring the necessary equipment from Mexico. In a solemn ceremony in February 1733, the seals and other equipment for the Royal Mint were received in the city of Santiago de los Caballeros de Guatemala (today known as Antigua), and installed in a house next to the Palace of the Captains General. On March 19, 1733, the first coins were struck in Guatemala.

"Macacos" And "Columnarios"

To make these first coins, an old-fashioned process was used. Silver was melted down to produce small ingots wide enough to make the different coins worth 8, 4, 2, 1, and ½ "reales." The official marks were applied by hammering the dies on these bars, and the ingots were then cut into pieces having the approximate weights required by law for each value. These pieces were later trimmed to bring the weight down to the exact one desired for the value stamped. The method was primitive, probably antedating the times of Caesar. But Guatemala at last had its own mint, and was able to ease the serious situation caused by lack of currency.

These clumsy, shapeless "macacos," as they were called by the people, were minted, both in gold and silver, until 1754. By this time the Royal Mint was said to have processed into coins over 508,000 marks of silver and about 2,124 marks of gold. Few genuine "macacos" have survived to this day.

In May 1751, however, King Ferdinand VI of Spain had issued a Royal Decree ordering that circular-shaped coins must replace the formless ones being minted. For Guatemala to comply, it was necessary to bring more equipment into the Mint, all of which was again obtained from Mexico. By May 1754, the Guatemalan Mint was ready to start turning out circular coins. Since on one side they had the Spanish coat of arms flanked by two columns, the new coins were quickly dubbed "columnarios" by the people. It was not long before they had replaced the ungainly "macacos."

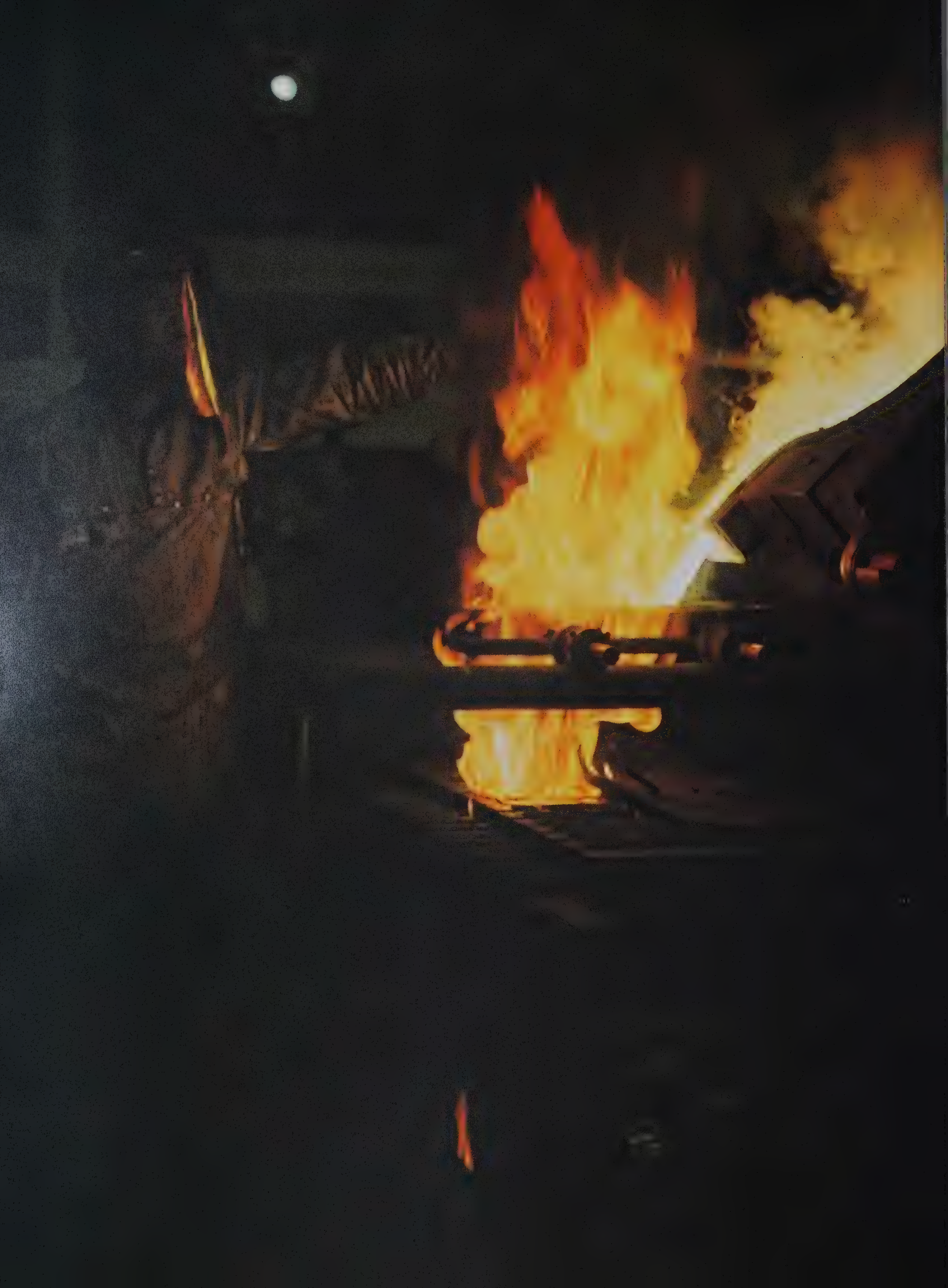
Two Centuries Of Service

In July of 1773 a series of earthquakes wrecked the city of Santiago de los Caballeros de Guatemala. Among the shattered buildings was the Mint. By royal order the city was moved to its present location, where the new capital was formally inaugurated in 1776. The Mint existed in makeshift quarters in the new city until 1779, when it was transferred to the building it occupied until this past September. Badly damaged by earthquakes in 1917-18, the structure was repaired and the Mint continued functioning.

On September 15, 1821, Central America declared its independence from Spain, and Guatemala's Mint was put to work turning out coins for the new republic. The Mint continued to operate under successive governments. New issues were limited to silver and gold up to 1870, when brass was used for the one-cent and two-cent coins.

In 1871 the first copper penny made its appearance, and in 1900 the first nickel coin. Nickel was the basis of issues in 1900, 1901, 1910, 1911, and 1912, when because of war requirements it went out of use. Later, mainly in recent years, it was to come back.

In 1964 Guatemala ordered the elimination of silver from its coins, and in



Flames leap up as Mint workers pour molten metal.

(Above) The modern facade of the new Mint building.

(Below) Guillermo Erazo L., who manages the Mint.

President Julio César Méndez Montenegro addresses guests invited to the inauguration of the new Mint in Guatemala City on September 13, 1968. Seated at the table, from left to right, are Lic. Francisco Fernández Rivas, President of the Bank of Guatemala; Lic. Francisco Villamar Contreras, President of the National Congress; and Colonel Ariel Rivera, Governor of the Department of Guatemala.

1965 began turning out new ones of nickel silver, with 61 per cent copper, 20 per cent zinc, and 19 per cent nickel content. This alloy, in addition to being cheaper, proved more resistant to wear than the old silver alloy coins.

Latin America's Most Modern Mint

The new Mint can turn out from 250,000 to 300,000 coins a day. In fact, it has sufficient capacity to mint currency for other countries. Built at a cost of almost a quarter of a million dollars, it has a floor area of nearly 34,000 square feet. The modern, clean-line principal structure houses the main workshop with electric furnaces, rolling mills, punches, annealing furnace, hydraulic presses, and other equipment, as well as raw material vaults, vaults for the finished coins, offices, lunchrooms, and kitchens. There is a guardhouse at the entrance gate to check all incoming and outgoing traffic. Although some equipment was brought from the old Mint in the centre of the city, most is new.

Until 1959, the Mint operated as a dependency of the central government, but in September of that year the Monetary Board decided the Mint should be managed directly by the Bank of Guatemala, the Government's central bank. Lic. Luis Diáz Gaitán, Director of the Treasury and Currency Issues Department of the Bank of Guatemala, is the head of the Mint. Guillermo Erazo L., as head of the Bank's Mint Section, actually manages the Mint, and his Assistant Manager is Chemist Raúl Valdeavellano.

Coins And Medals

The new Guatemalan Mint does not print paper money. Its activity is limited to bringing out metal coins, which under the Government's Decree Law No. 265, dated August 20, 1964, are in the 50¢, 25¢, 10¢, 5¢, and 1¢ denominations. All are of nickel silver except the one-cent denomination, which is of a copper-zinc alloy.

In June 1965, the Mint brought out a series of three gold medals to commemorate Guatemala's national hero, Tecún Umán, the Quiché Indian chieftain who defied the Spanish invaders in 1524 and was finally killed in personal combat by the Conquistador, don Pedro de Alvarado. Again in March 1966, the Mint brought out a large gold medal to commemorate the inauguration of the Bank of Guatemala's new building. On one side the medal bears an engraving of the new structure, and on the other a reproduction of Temple No. 1 at Tikal, the great Mayan archaeological site in the country's northern jungles. Both series of medals have become collector's items.

With nearly two hundred years of service to its credit, Guatemala's Mint looks to the future with the most modern facilities in Latin America.

A permanent resident of Guatemala since 1956, J. Alfred Barrett served for five years as Public Relations Adviser for the Guatemalan National Economic Planning Council. In 1965, he became Public Relations Counsel for Exploraciones y Explotaciones Mineras Izabal, S. A. (EXMIBAL), a majority-owned International Nickel subsidiary. He is senior partner in the Guatemalan public relations firm of Barrett, Ribas y Cía, Ltda.

Photographs by Joya Hairs, Guatemala City

To one of France's most widely known landmarks, the Cathedral of Chartres, come thousands of tourists every year.

A VALUABLE NATIONAL RESOURCE IN DANGER

by PIERRE DE LAGARDE

In this article, Pierre de Lagarde is speaking primarily to Frenchmen—about a major problem confronting France. But the situation he describes, and the dilemma it poses, are not unique to France. Nearly every nation concerned with preserving its heritage from the past in the face of a rapidly expanding industrial civilization is confronted with the same situation, to a greater or lesser degree—and the same dilemma. De Lagarde's analyses and proposals are therefore not national; they are international in relevance and interest.

So far as historical and artistic monuments are concerned, France is the richest country in Europe. For eight centuries, she has been the mother of every architectural style. She invented the romanesque, in the south near Toulouse, and covered the countryside with innumerable expressions of its basic form. She raised aloft in the Ile-de-France the first gothic vault. Yet, having multiplied masterpieces of this style, she was the first to surrender, in the northern part of the country, to the mystical delirium of the "Flamboyant." Then came the 16th century, which Sainte-Beuve called the "time of fertile and powerful dispersion." This century is admittedly Italian, but, during it, distinctively French architects and masons gave the valley of the Loire that incomparable diadem of chateaus which has never been equalled anywhere else.

In the 17th century, the "steamroller that spread the green carpet lawn of Versailles" kept France away from the undeniable riches "that the expressive motion of baroque" gave to other countries. Nevertheless, it prepared the way for the quiet harmonies of the French style, those masterpieces of 18th-century town-planning and the numerous stately mansions, with their demanding yet gracious lines, which can still be found throughout the provinces.

As Proust said about man, France is "a country which is measured not according to its size but by its years." Thus she can offer exceptional testimony to the architecture of past centuries.

A Peerless Heritage In Danger

The art lover has, therefore, every reason to rejoice in France's abundance of monuments, an abundance which is surpassed by no other country in Europe. But at the same time that he can delight in being able to visit so many churches, chateaus, manor houses, and mansions, he may begin to tremble because this peerless heritage is in terrible danger.

First of all, we must take into account the many blind forces that often accompany every new form of dynamic progress. For example, the industrial civilization which we entered a century ago has been accelerating its rhythm of development since World War II, and is now promising us gigantic towns. In twenty years, France will have, not eight cities of over 200,000 inhabitants, but thirty-two balanced metropolises of this size, in which will live more than half the French population. The population of the metropolitan Paris area will grow from six to fourteen million. We will even witness, according to the experts, the development of linear urban nebulae which will extend over hundreds of miles. Already there is in Germany a nearly continuous city extending from Mayence to Cologne, and it is probable that, by the end of the century, there will be another continuous urban complex linking Amsterdam to Paris.

These new urban units run the risk of swallowing up and devouring large numbers of monuments of the past. Old districts, which have been permitted to decay unprotected for more than a century, but which form a unique setting for our cathedrals and give a particular charm to our cities, are mercilessly threatened. They will be pulled down by bulldozers and replaced by buildings of an often distressing architectural merit.

Moreover, charming villages and magnificent estates alike will be destroyed by those modern monsters known as industrial zones and public housing projects. In the Paris region, we have already witnessed the disappearance of the chateau of Sucy-en-Brie, where a housing project of rather dreary skyscrapers was built within a few meters of a building dating back to the 17th century.

Of course, it is not a question of combatting urban concentration, which is not only inevitable but linked to the economic progress of every modern country. But I believe that this can be undertaken, and well, without having to sacrifice an artistic inheritance whose importance to the nation's cultural progress we come to understand better every day.

Agents Of Destruction

Urban concentration is not, unfortunately, the only blind dynamism which threatens us. Technical progress can also be a ruthless Moloch.

The automobile is a devourer of monuments. In the centres of the larger cities the widening of streets and boulevards has caused irreparable damage. If we want to adapt the old districts of Paris to traffic we will be forced to sacrifice them—whether they be the Marais or the Faubourg Saint-Germain. This is true everywhere.

To the automobile can be added another destructive agent: the airplane. Today, many feudal castles and old country churches, which, because they were far away from the main arteries of communication, had escaped previous menaces, crumble under the ear-splitting "bangs" of the jetliners.

Under the repeated blows which they receive from all sides, our monuments of the past—destroyed, mutilated, dishon-

(Above) Within a few yards of the 17th-century chateau of Sucy-en-Brie, a housing project of skyscrapers has been built.

(Below) Disfigured by the crushing mass of an adjacent modern structure is the Hotel de Sens, an architectural gem built at the juncture of the Middle Ages and the Renaissance.

oured – disappear or lose their brilliance. One could think of France's architectural heritage what Ronsard sadly said of himself in his last years:

"without flesh, without feeling,
  without strength, without blood,
my body is declining to the point
  where everything is falling apart."

Buildings Without People

Other economic and social phenomena are going to add their pressure, more indirect but none the less strong, to these agents of destruction.

The countryside is becoming more and more deserted. At the turn of the century, the rural population of France was about 30 per cent. It is now 19 per cent. In twenty years it will be 9 per cent. It is estimated that some 12 million acres will no longer be under cultivation and that three million old houses, without the artistic value of the great monuments but with a definite charm, will be abandoned. With this gigantic upheaval, it is the very face of France—the France of George Sand, of Balzac, and of Proust—which may disappear forever.

This is a phenomenon, of course, which is not peculiar to the present, but never has the deplorable move away from the rural districts been on such a scale as it is now. Not only the fortified chateaus but nearly all the country mansions and churches are in danger of disappearing.

In the age of central heating, the chateau has become uncomfortable and the type of staff required to maintain it has completely vanished. With its roof to be repaired and its interior decorations to be protected, it presents too heavy a burden for its inhabitants who, as a result of the inheritance laws, do not have the fortune of their ancestors. The same phenomenon afflicts the churches. The movement away from religion, as well as depopulation in rural areas causes a progressive abandonment of religious buildings. Municipalities in charge of their maintenance do not see why they should make financial sacrifices when so few people attend church services. This, alas, is the prevailing condition in departments like Yonne or Charente, which have the most beautiful churches in all of France.

Tourism And The Economic Future Of France

I am convinced that the wealth of France depends to a certain extent on the fate of these monuments in the years to come. Tourism is, in France, the third largest national industry but it is far from having the importance it should have. In certain European countries, it assumed first place some time ago. This is the case in Switzerland, where it ranks far ahead of the chemical industries, and in Italy, where tourism makes it possible, with twenty-four million foreign tourists, to balance the national budget.

In twenty years time, tourist activities will have taken on an importance that we are far from suspecting today. It will not only be a question of welcoming thousands of visitors to Paris, to Mont Saint-Michel, and to the chateaus of the Loire, but of directing tourists towards other charming places—like the Romanesque churches of Provence, the manor houses of Normandy or Brittany, the fortified chateaus of Cantal, the monasteries of the Ile-de-France—in short, toward all the monuments, from the little church at Yonne to the chateau of Gers, from the Morbihan chapel to the Cantal fortress.

Furthermore, foreigners by the thousands will undoubtedly be coming to settle in France. In twenty years time, people from Stockholm, Hamburg, or Berlin will be regularly spending the week-end at their country homes in Lot, the Maritime Alps, or Lozère.

Thus, monuments which have so long been considered useless burdens will come to represent invaluable capital for France and will be the most important sources of wealth that certain provinces can count on. Regions outside of the major European axes of communications, such as the Rhine basin and the Rhone valley, near where the large cities and industries will develop, will have their scenery, their picturesque villages, and their small chateaus as their resources. This capital, if properly managed, will be enough to maintain the local economies.

To Give Life A Sense Of Meaning

But the economic future of France is not the only concern. The nation's social future is also at stake. In a recent publication, *What Will We Be Doing Tomorrow?,* the author promises the French of the year 2000 that they will enjoy twice as much leisure time as they do today. A priceless, but at the same time poisoned, gift, because sociologists already fear that our children, if not ourselves, are already seriously threatened by boredom. "What is to be done with all this free time?" is a more serious question than it might appear at first sight. Indeed, statistics point out that there are many French people who die shortly after having retired from work, because most of them have not been able to find a secondary activity, a hobby, essential to their psychic balance.

But, the monument is there, waiting for us. It represents, because of the work and the care it requires, a privileged leisure-time activity. Not only does it keep the arms and body busy, but also the head, the mind, and even the heart. It is one of those rare activities that can give a sense of meaning to an entire life.

The difficult, dessicating life that industrial civilization imposes on 20th-century man calls out for a return to fundamentals. The uprooted man in our cities needs to recapture traditional values which have accompanied mankind on its progress through the centuries, not in order to cling to the past but in order to participate in a philosophy and in a wis-

dom which even in the 20th century remain profoundly human. And the work of art, more than any other instrument of culture, can immediately make us participate in the different humanistic philosophies elaborated by the generations which have preceded us.

Their Power Remains Unequalled

The work of art will be, twenty years from now, the privileged vehicle of culture, again not because of the past but because of the future. In the 19th century the book and the newspaper were practically the only means of information, of instruction, and of self-culture, but things have certainly changed since then. With the movies and television assuming an ever larger place in modern life, little by little the visual image is dethroning the written word. Some people do not hesitate to deplore the situation, promising that with the further development of audiovisual media we will become a race of illiterates. Are they right? This is not so obvious. The visual image is not only the comic strip, it is also the work of art whose power of poetry and fascination remains unequalled.

Undoubtedly, it is only the experts who read *The Song of Roland*. On the other hand, a hundred thousand tourists come to dream each summer before the royal

Until about 1830, the Hotel Liberal Bruant was one of the most elegant residences in the old Paris district of the Marais. Today it is nearly enveloped by buildings considerably less distinguished.

A graduate of the University of Paris, Pierre de Lagarde joined the "Radio-Télévision Française" (ORTF) in 1958, in its news section. At an early age, he had become interested in the historic buildings and monuments of France. To awaken public interest in the distressing condition of many of them, he created the radio program devoted to "Chefs-d'Oeuvre en Péril" in 1962 and subsequently the television counterpart—programs in which he is still active. The public response has been excellent: On December 1, 1968, one television program made it possible to raise 2 million francs to restore the magnificent chateau of Hautefort (Dordogne), which had been partly destroyed by fire.

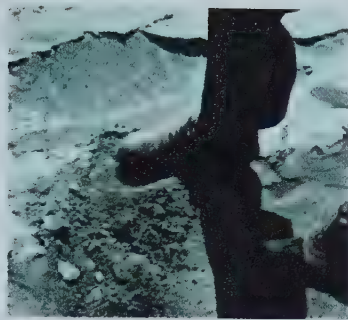
portal of Chartres. And it is the same message that is conveyed. The lesson which the old bards of the Middle Ages cannot transmit to us any longer is presented today by the enigmatic figures standing against the portals of our cathedrals.

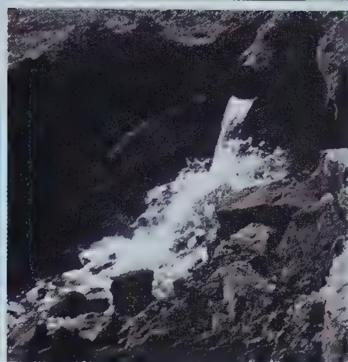
In spite of the indifference and negligence on the part of a large number of our contemporaries, we do not believe the situation is hopeless. The castles, the chapels, the keeps—when they were still living and active, they looked down on their neighbours from the height of their intact facades or from their proud turrets. One passed them by without seeing them, almost disturbed by their overwhelming presence. But since they have come to show their wounds, since they call for help from under a suffocating blanket of ivy, brambles, and nettles, since their wounded pride is nothing more than an anguished cry, even the simplest of men are moved. The ruins rediscover the "kind of vibrant immobility" in which Jean Cocteau saw the essence of the work of art, and those who live beside them search, in contemplating them, for the meaning of "these mysteries," as Proust calls them, "which probably only have their explanation in other worlds, and the premonition of this is that which moves us most in life and in art."

PICTURE CREDITS

Page 17: French Embassy Press and Information Division, New York
Page 18 (above): Philippe Degoy
(below): O.R.T.F.
Page 20: O.R.T.F.
Page 21: Maps by Bernard Gervey, based on material in *2000*

In 1968 France had eight cities of over 200,000 inhabitants. By the year 2000, twenty-four other metropolises will have appeared on the map of France.





Rye on the Rocks

Ask anybody in a mining town—anywhere—about tailings. Ask people in Sudbury, a city in northern Ontario. Their whole way of life depends on the nickel mines—and they know it—but at the same time, they have had to live with the problem of tailings for sixty years.

Tailings—a waste product...50,000 tons of it a day...sterile as the surface of the moon. Somewhere, at the end of every mine, there is a tailings dump. It is the price the mining town pays for its existence. In most places, it is an unsolved problem—an eyesore, black and glistening for miles, with not a blade of grass.

Just outside Sudbury, International Nickel has turned the eyesore into acres of green. A permanent solution: grass... and trees...and even crops. Mining people from all over the world come to Sudbury to see how plants are made to grow on bare, sterile mine tailings.

To Grow Grass Without Soil

In the 1950s, International Nickel handed the tailings problem over to the company's Agricultural Department, headed by Clare Young. They started with hydroponics, the science of growing plants without soil, and brought this technique out to the tailings to grow grass. The idea was to develop a turf that would hold the tailings down.

Weeds, Japanese bamboo, even twitch grass—all met their match in the sterile and unbelievably hot surface of the tailings. Finally, Canada bluegrass, with rye as a companion crop, was tried. When the grass on the first plot grew—and persisted for three years, the experiment had become a success. Larger areas were planted and harvested, and each year the process began on new stretches of raw tailings. Over 500 acres have so far been converted to pasture land.

The first planting was nearly ten years ago. Today, Inco agriculturists can grow grass almost anywhere on the tailings. Some patches are obstinate, but the grass is gradually taking them over. Trees are planting themselves and birds are coming back. What nature does in centuries, these men want to do in one lifetime.

Most of the photographs and much of the text on these pages are taken from a 14-minute color film, Rye On The Rocks, *recently produced by The International Nickel Company of Canada, Limited. The film is now available in Canada.*

Freising Cathedral, built in 1160. Here rests the body of Korbinian, first Bishop of Freising, who founded Weihenstephan monastery in 725.

Weihenstephan

The Brewer's Mecca

by DR. HANS ST. STEFANIAK and PETER MEINKE

Half-an-hour's drive from Munich, capital of the German state of Bavaria, there rises above the fertile Erdinger Marsh a landmark known as Weihenstephan Hill. Situated on the border of the ancient diocese of Freising, it commands a view over the Upper Bavarian plateau to Munich and the Alps beyond.

On this hill, which has been inhabited from ancient times, stand the mellow, pale gold buildings of a former Benedictine abbey. Here beer has been brewed for more than a thousand years. This is the district where that delectable beverage—that builder of bonhomie—"true beer" containing hops, was almost certainly brewed, and tasted, for the very first time. A document of 768 A.D. mentions a hop garden close to the monastery of Freising, and from these hops beer was undoubtedly brewed. The monastery's brewing and selling rights were later transferred to the neighbouring Weihenstephan monastery.

The Benedictine fathers of Weihenstephan have long since left the abbey, but the brewing tradition they established lives on. These buildings now house the Faculty of Brewing of the Technical University of Munich, a remarkable institution whose research and teaching activities are world-renowned. Weihenstephan today is the Mecca of all good brewers.

An Educational Centre For Brewing

How did an abbey brewery become a university faculty? The development was a gradual but logical one. The abbey, founded in 725 A.D. on the "Mons ad Sanctum Stephanum" (St. Stephen's Hill), became a centre of monastic culture. Its school served, among other things, as an educational centre for husbandry and brewing, and was the oldest of its kind. The school was already famous when, in 1803, after the secularization of the monastery, it was transferred to the Bavarian government as the "Central Agricultural School." From 1865 onwards the students of brewing were separated from the students of agriculture and took their own examination. Thirty years later came the foundation of the Royal Bavarian Academy for Agriculture and Brewing. In 1920, the academy became the "University for Agriculture and Brewing" and ten years later the Faculties of Brewing and of Agriculture were incorporated in the Technical University of Munich. Extensive reorganization of the brewing and engineering courses and enlargement of the premises and staff of the Brewing Faculty have taken place over the past ten years and should be completed by 1970.

From Manual Craft To Large-Scale Industry

This development on the academic side reflects the enormous expansion of the brewing trade itself from a manual craft to a large-scale industry requiring constant development and change.

Originally there were thousands of small brewing establishments in beer-loving Bavaria (which still holds the per capita record for consumption), making beer for immediate drinking and selling it on the premises. The industrial age changed all this. With the development of manufacture, trade, and transport, and with the growth of cities, conditions were ripe for the development of the large-scale brewery.

By this time the beer brewed was predominantly of the bottom-fermented type. In this, the yeast settles at the end of the fermentation or storage stages. The invention of mechanical refrigeration in 1876 by a Munich professor, Carl von Linde, was of great value, for it became possible to make beer in large quantities, store it, and distribute it throughout the world. (Incidentally, the English term, "lager beer" comes from the German "lagern," meaning "to store.") Beer brewing became a highly-capitalized industry. In Germany alone there are today 2,000 breweries producing about 75 million hectoliters (1,650 million gallons) per year. Some of these breweries are "hectoliter millionaires."

In such changing circumstances, it was no longer practicable to brew beer according to the old jealously guarded recipes watched over by manual craftsmen. Instead, it became necessary to carry out scientific research into the extremely complex processes of malting, crushing, mashing, wort boiling, fermentation, storing, and filtration, and into the associated biological, bacteriological, physical, and chemical phenomena involved, and to apply the results in practice on a large scale.

Diplom-Ingenieurs Und Diplom-Braumeisters

The extensive knowledge and multifarious skills that the would-be brewer must acquire today can best be seen from a list of chairs in the Faculty of Brewing

In the brew-house, an experienced brewer shows two students the break formation (the coagulation of the albumen and its combination with tannins) in boiling wort. The copper vessels are used for boiling the wort, the first stage of beer.

In this sterilizing room, three-foot thick walls of the old Benedictine monastery make a striking contrast with the sterilizing cart and other modern equipment of nickel stainless steel. Through the window can be seen a fresco on the Bavarian State Brewery wall, illustrating the "Life Story of Beer."

at Weihenstephan: brewing technology; chemico-technical analysis; theory of machinery and apparatus; machinery and power economics; mechanics; physics; technical microbiology; economics. In addition, there are teaching arrangements with other faculties of Munich Technical University and with instructors from industrial and commercial concerns.

In the full study course, which since 1958 has covered eight semesters, or four years, students qualify for the academic degree of "Diplom-Ingenieur," roughly equivalent to a bachelor's degree in science or engineering. There is also a four-semester (two-year) academic course, qualifying the student as a "Diplom-Braumeister." An essential feature of both courses is adequate practical instruction.

At Weihenstephan, "Practice" joins "Research" and "Theoretical Instruction" to form the three pillars of learning. Linked with the faculty and included in the means of instruction are the Instructional and Testing Brewery and the Bavarian State Brewery. The latter, founded in 1040, is the oldest brewing establishment in the world. In addition, there is the Weihenstephan Testing Establishment for Brewing Technology, largest of its kind, which assists, through its advisers, nearly 1,000 breweries in and outside Germany, carrying out 50,000 analytical tests per year. The Weihenstephan State Trust Ltd. and the Technical Institute for Brewery and Malthouse Construction are associated with the faculty through professorships. Their function is to provide advice on the commercial, constructional, and mechanical engineering aspects of brewing. Practical work is also carried out in connection with the annual "Brewing Economics Week," which is held at Weihenstephan and has the object of informing breweries in Germany and elsewhere of the latest developments and of the results of research, from both the economic and technical standpoints.

In Munich And Milwaukee

The 400 students of the faculty, 10 per cent of whom are from other countries, thus have the opportunity of working in a research and educational establishment that is unique in the entire world. For this reason, Weihenstephan graduates are to be found in the beer strongholds of all five continents–not only in Munich and Dortmund, but in Milwaukee, Pilsen, Copenhagen, Liverpool, Brussels, and Strasbourg, and even in lands like Mexico, Argentina, Brazil, and Chile. Graduates of Weihenstephan also work in many related branches of the foodstuffs industry, in the wine and spirits industries, in pharmacy and biotechnology, in food inspection, and many other areas.

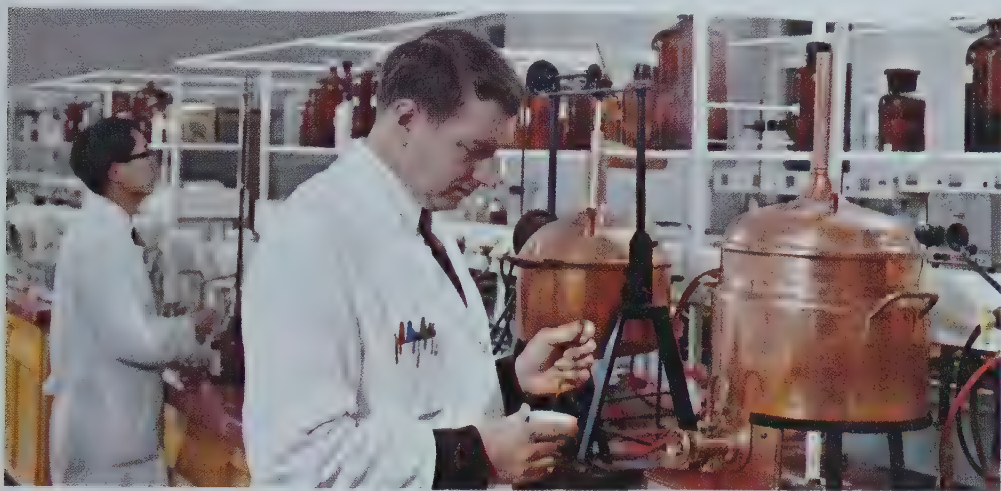
Purity Above All

Even though research is carried out and instruction given using the most modern methods and equipment, Weihenstephan is immovably conservative on one point—observance of the Purity Law. A decree made by Duke Wilhelm IV of Bavaria in the year 1516 specified that beer could only be brewed from malt, hops, yeast, and water. The first definite foodstuffs law, it laid the foundations of the worldwide reputation of Bavarian beer. It is still in force today.

The isolation of trace elements in beer by means of chromatography. Trace elements influence enzyme activation in the mashing process and the nourishment of the yeast in fermentation.

The thermometer in this test room shows a temperature of almost 30°C, the optimum for breeding microorganisms. Beers from many breweries are studied and analyzed for several weeks at this temperature. The results obtained give information about the stability of the beer and provide an index to the biological conditions in the brewery.

A small brewing installation with wort boiler, straining vat, and mash vat (obscured) reproduces the brewing process carried out in the brew-house to the scale of 1:1000 (by volume).



The boiling-hot wort in the brewing-house is clarified by a "hot wort separator" and cooled in the plate cooler before it reaches the fermentation cellar. Students are taking a wort-sample from the chromium-nickel steel hot wort separator.

The only ingredients allowed to be used in the beer are barley malt (or wheat malt in the case of top fermented beer), hops, yeast, and water. Any other additives, such as preservatives or colouring matter, or processes that accelerate or interfere with the natural microbiological action of the brewing process, are strictly taboo. The ancient brewer's saying, "Hopfen und Malz, Gott erhalt's" ("Hops and malt, God preserve it"), is still taken literally here. This is the only way of guaranteeing that beer drinkers, even if they are enthusiasts, will be able to spend a merry evening without suffering from hangover the next day.

Wherever Beer Is Appreciated

As Professor Schuster expressed it at the centenary celebrations of the Faculty: "For a hundred years, Weihenstephan has been the gate through which young brewers and technicians having an all-round education have gone out into the world, to apply the knowledge and skill they have acquired. It is certainly no accident that today all over the world, wherever beer is appreciated, Weihenstephan men in one way or another, and often working under primitive conditions, have made their contribution to the brewing of good beer in accordance with the arts and doctrines of Weihenstephan."

PICTURE CREDITS
Pages 26, 31 (right): R. Maynard-Smith, Inco Ltd.
Pages 27, 28, 29, 30, 31 (left): John Stone, Inco Ltd.

A Guarantee of Purity

In the brewing industry, where purity is so important, stainless steel has long been a vital material. Chemically neutral, it creates no corrosion by-products to interfere with the brewing process. High and low temperatures make no difference to stainless steel. Its surface, smooth and free from pores, is easy to clean and to keep clean.

Nowadays, nickel stainless steel is used for all parts of the brewery plant that come into contact with raw materials or the finished beer, from mash tuns to filter vats, from storage tanks to beer barrels—even to the bottle cleaning and filling plant. And in bars and taverns throughout the world—wherever beer is served to the public—the bar counter, the drains, and even the taps themselves are made of stainless steel.

Pictures by kind permission of the Weihenstephan authorities.

Prof. Dr. rer. nat. habil. Hans St. Stefaniak, who served as Dean at Weihenstephan from 1966 to 1968, was trained in technical physics. He came to the Faculty of Brewing as head of the Institute of Brewing Machinery in 1961. Besides mechanics, the Institute deals with the flow and control problems so important in beer production. As Dean he continued Weihenstephan's expansion program.

Assistant lecturer at Weihenstephan since 1964, Dipl.-Ing. Peter Meinke instructs students in higher mathematics and assists members of the faculty with the use of digital computers.

CANADA'S ESKIMOS AND THEIR ART

by GEORGE SWINTON

While we are accustomed to think of the Arctic as lying north of the Arctic Circle, it is probably more meaningful and practical to describe it as that immense area of land—tundra, mountains, glaciers—and water that lies north of the timber or tree line. That line, by the way, dips 700 miles south of the Arctic Circle at the eastern shores of Hudson Bay and stretches almost 200 miles north in the western parts of Canada's Northwest Territories. South of the line, the native population is Indian; north of the line, it is Eskimo. Of the world's 56,000 Eskimos, some 13,000 call the nearly one million square miles that make up the Canadian Arctic their land and their home.

The Eskimos were probably the last of the early settlers to reach North America, arriving some 5,000 years ago. Contrary to popular opinion, there was no single continuing Eskimo culture; instead there were several distinct cultures, each with its own traits and traditions, like the Pre-Dorset from about 2800 to 700 B.C., followed by the Dorset culture lasting another 2,000 years until roughly 1000 A.D. The Dorsets were gradually displaced by the Thule Eskimos (the immediate "ancestors" of the contemporary population), who had started their eastward move across the Arctic from the Bering Strait in the 10th century and who, in turn, disappeared as a distinct culture by 1800.

WOMAN HOLDING A FISH AND AN ULU. *This 10½-inch-high carving of serpentine and inlaid ivory was produced by Johnnie Inupuk at Port Harrison in 1954.* (Art Gallery of Ontario)

These cultures not only differed in their material aspects—as manifest in distinct types of tools, weapons, and art—but also in their settlement patterns and in their physical makeup. Yet in spite of these differences, all prehistoric Eskimo people were nomadic or semi-nomadic hunters who—almost up to this century—lived entirely from the land or from the sea.

Into A New World

Significant changes in the traditional ways of life of the Eskimos started to occur at the beginning of the 19th century with the arrival of the American and Scottish whalers, followed by the many expeditions in search of a Northwest Passage, and the even more numerous searches for the lost Franklin expedition. Concurrently with these ventures, traders (particularly the

ENCHANTED OWL, *cut from stone by Kenojuak at Cape Dorset in 1960.*

Aggiak used green serpentine to create LEGENDARY SPIRIT. *Done at Cape Dorset in 1963, it is 19 inches long.*
(Montreal Museum of Fine Arts)

Hudson's Bay Company) and missionaries (almost exclusively Anglican and Roman Catholic) started to arrive in increasing numbers. The former totally self-sufficient subsistence economy of the Eskimo gradually began to change into a partially white-man-oriented barter economy. Finally, in the post-World War II world, with the establishment of Canadian government services and the U.S.-supported DEW line, the Eskimo economy began to change to a money economy with largely permanent settlement patterns.

Today, about 80 per cent of Eskimo income derives from wage employment, cottage industries, and welfare services (with an annual per capita income of slightly less than $530), and over 85 per cent of the population now resides in durable dwellings located in some 40 permanent communities (in contrast to only ten years ago when over 80 per cent of the

This MUSK OX, *carved by Tattener at Baker Lake in 1963, is made of soapstone and musk ox horn.*
(Collection of J. F. Twomey, Winnipeg)

Rankin Inlet, in Canada's Northwest Territories, is typical of Eskimo communities today. Gone are the traditional igloos – replaced by structures that are artistically less pleasing.

Above the tree line (which is North of the green area shown on the map) live the 13,000 Eskimos of the Canadian Arctic.

Eskimo population lived in hundreds of small hunting camps). Add to these some education statistics—such as today's enrollment of 85 per cent of all Eskimo children in 41 Arctic schools, as compared with less than 20 per cent in only eight schools a decade earlier—and it is not very difficult to gauge the immensity of the cultural change that has taken and that still is taking place today.

The "New" Art

Inasmuch as this sudden plunge into the 20th century implies the almost complete displacement of a very congenial and highly successful "natural" way of life that lasted almost 5,000 years (and involved the most astounding capacity of man to adapt to and survive the most adverse conditions imaginable), the current state of acculturation is regarded by many as a deplorable event. Others disagree, and admire the Eskimo's new proof of adaptability, his being able to move so rapidly from a Stone Age culture into the atomic age. If art reflects the conditions of life within a culture—and many believe art does—then doubtlessly the new ways of life contain a high degree of vitality and vigour, in fact, surprisingly more than probably existed in the last two hundred years – that is, if we can trust the evidence of art. Personally, I am inclined to trust this evidence more than statistics, always prone to manipulation.

Just what then has this "new" art of the Eskimos to tell? In the first place, it tells that it is new, that it is different from the old. Secondly, it reflects a white-man orientation, not as much in techniques as in purpose, content, and form. And finally, because it breaks so markedly with the past and the differences are so well defined, the new art not only contributes to the establishment of new traditions within a new culture but also helps to define this culture itself.

The Meaning Of Words

The newness of the new art manifests itself in a variety of ways. First of all, the Eskimo never had a word for art. But now, with the conscious attempt to produce art, a carving becomes a *Sanangoagak*—a "being-reproducing-work," as opposed to a *Pinguak* – an "imitation-of-a-thing," such as a toy. A very subtle and appropriate distinction indeed! In this connection one might mention that the word *Eskimo* derives from an Algonquian term meaning "eaters of raw meat." But Eskimos themselves, like so many other of the world's native people, call themselves *Inuit*—"the people," the plural of *Inuk* meaning "man." And while the Eskimos have no word for art, their word for "soul" is *Inua*

In whalebone six inches high, Ahlooloo's COUPLE *was created at Arctic Bay in 1961.* (Collection of J. F. Twomey, Winnipeg)

This work by Johnnie Inupuk, MOTHER FEEDING CHILD, *is a soapstone carving 19 inches high. Inupuk completed it at Port Harrison in 1962.* (Collection of M. F. Feheley, Toronto)

—"that-which-is-*of*-man," while all art objects are unmistakably *Inunnit*—"things-which-come-*from*-man."

Eskimo art today seems to have become a predominantly commercial product, i.e., a product produced not for one's own use, but for the use of others—the use of the white man, to be sure. But this in itself is not altogether new for the Eskimo, inasmuch as *Pinguaks* (toys and replicas) have been used as trading objects and souvenirs for the past century and a half. And during the same time Eskimo scrimshaw articles included such mundane objects as cribbage boards, candle holders, bookends, match boxes, and umbrella handles.

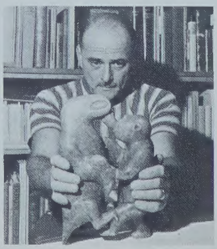
What is really new about today's production of Eskimo art is that it so much resembles our own which, in spite of commercialism, has become a very expressive outlet for spiritual beliefs and creative energy. Thus, while on one hand commercialization of art reflects social and cultural disorientation and devaluation, it has nevertheless initiated new streams of creativity and sophistication which in the past existed in the ritualistic life of spiritual hunters but which had all but disappeared in the largely secular lives of mostly mercenary trappers and traders.

A Miracle Amid Hang-ups

Of course, with the increasing acceptance of white values on the positive side (individuality, creativeness, and corresponding rewards), troublesome problems were acquired in at least equal measure. White hang-ups become Eskimo hang-ups—the individual artist producing in a commerce-oriented vacuum. He may produce "his thing;" he is encouraged to produce "his thing;" but just what is "his thing" worth?

And then there are the hundreds of people—really non-artists, yet skillful and also needing money to survive in a money economy—who are asked to produce, and are producing, in an outside-their-world-of-interests world. Art is not "their thing" as individual human beings, but becomes a commodity that, as Eskimos, they are expected to produce.

These are the hang-ups, but the miracle is the very opposite: the discovery that art establishes a means for both cultural and individual survival. The ethnic content—Tattener's *Musk Ox* and Johnnie Inukpuk's *Woman With Fish*—becomes the vehicle of asserting one's past and one's present at the same time, just as Aggiak's *Legendary Spirit* and Kenojuak's *Enchanted Owl* not only introduce the mythology of the past but its continued existence in the thoughts and feelings of the living. Through art Eskimos can continue to exist as men—and things with soul and spirit. Spirit and soul return to culture.



With works in many public and private collections in Canada and the United States, including the National Gallery of Canada, George Swinton is a distinguished artist in his own right, in addition to being a leading authority and writer on Eskimos and their art. Educated at the University in his native Vienna and at McGill University in Montreal, he moved to Canada in 1939, and has been on the faculty of the University of Manitoba since 1954. He is currently working to assemble a major international exhibition of Eskimo sculpture.

PICTURE CREDITS
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